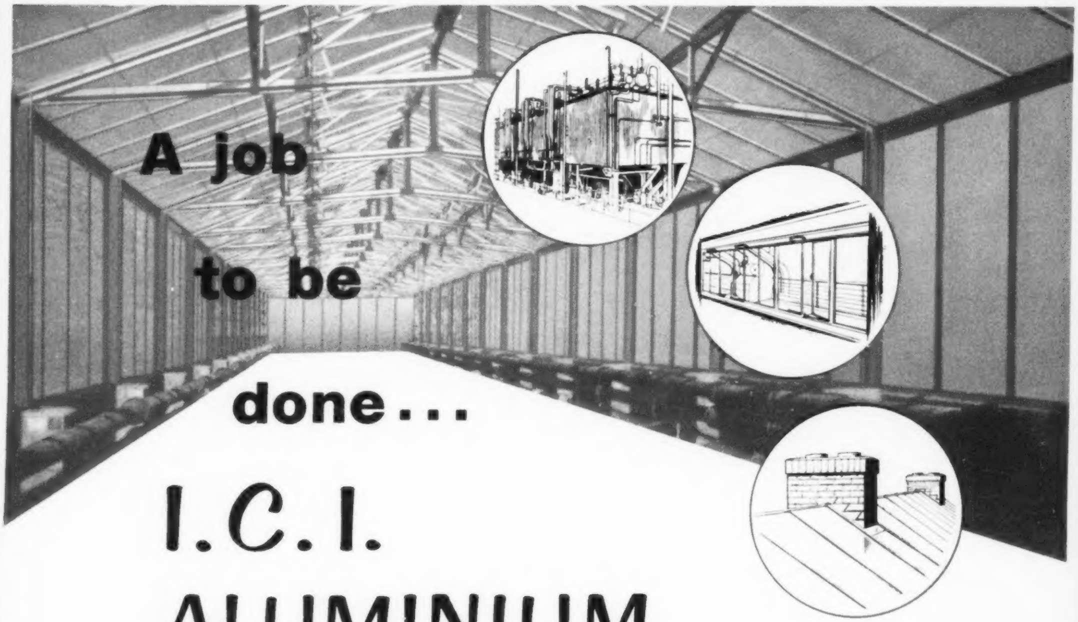
15 MAY 1959

METAL INDUSTRY

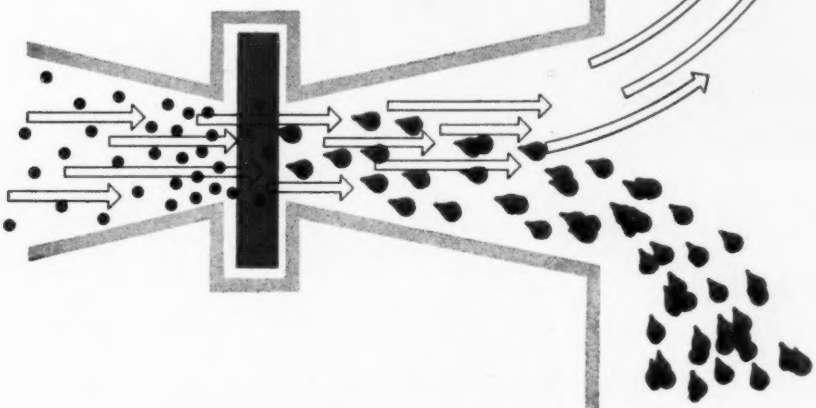
THE JOURNAL OF NON-FERROUS METALS



VOL 94 No 20

ONE SHILLING

For the elimination of atmospheric pollution, cleaning process gases and the recovery of valuable materials from gas streams by the wet scrubbing process



CHEMICO GAS SCRUBBERS

FOR INDUSTRY

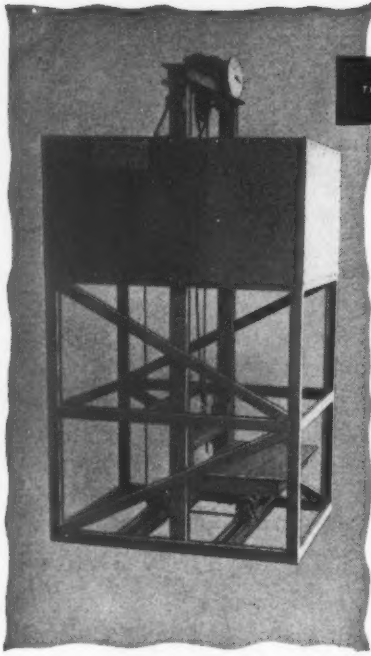
Typical applications include:

Blast Furnace
Oxygen Steel Converter
Open Hearth Furnace
Cupola
Electric Furnace
Non-Ferrous Smelting
Crushing and Screening
Coke Oven Gases
Rotary Kiln
Foundry Shake-Out
Sintering Plant
Plant and Pickling

Technical advice and illustrated literature on request.

CHEMICO

CHEMICAL CONSTRUCTION (G.B.) LTD. 9 HENRIETTA PLACE, LONDON W.1
LANGHAM 6571



THE RUSCOE TURNER SEMI CONTINUOUS CASTING MACHINE

CASTING CAPACITY

The die moulds, each 3 in. to 4 in. long are arranged for water-cooling and are carried on a hinged table on the upper platform of the machine. Billets can be cast as follows: up to 24 in. dia. by 10 ft. long can be cast singly. Two billets simultaneously up to 15 in. dia. Four billets from 6 in. to 12 in. Six billets up to 6 in. dia. Rolling slabs from 1 to 5 according to size required.

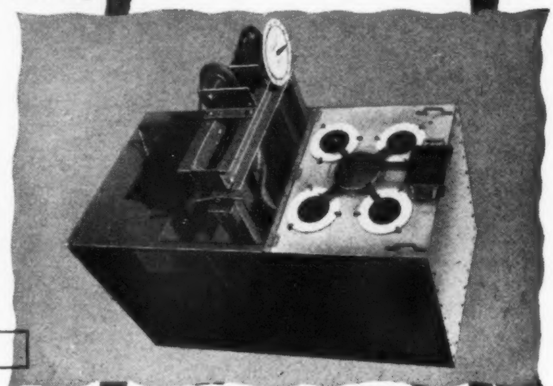
Patent Nos.,
British
617499 - 733913 - 19288/53.
Canadian
646220
Australian
19997/53.

★ Small Excavation Cost

★ Completely New Method

★ Low Running Cost

★ Cheapest and most reliable means of Semi-Continuous Casting.



Produces the highest quality billets. Maintenance costs practically nil. We can supply with machine Die Moulds, Pouring Box and Distributors.

ROLSAN. ENGINEERING LIMITED

82, FREDERICK ROAD, SELLY OAK, BIRMINGHAM 29
TELEPHONE: SELLY OAK 2519

METALS *in all Shapes & Sizes*

COPPER ALUMINIUM & LIGHT ALLOYS

BRASS TURNING RODS
$\frac{1}{16}$ to 8 ins.

TUBES · SHEETS · WIRES · FLAT HEXAGON · SQUARE RODS IN BRASS · PHOSPHOR BRONZE

Screws · Rivets and Small Machined Parts
Maxwell Frames

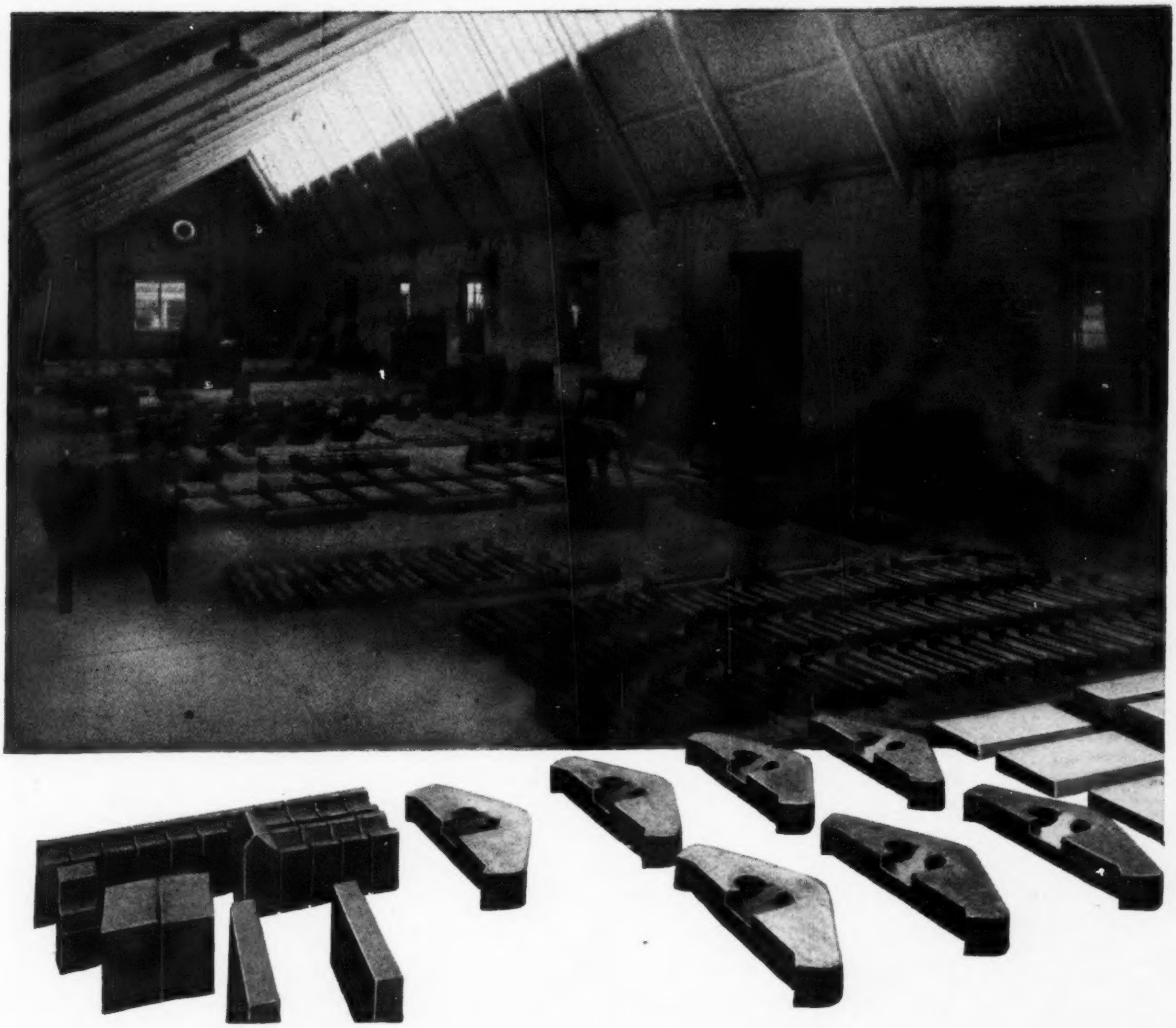
SHEARING & GUILLOTINING TO CUSTOMERS ORDERS

T.W. SENIER & CO. LTD.

115-121, ST. JOHN ST.
LONDON, E.C.1.

Phone: CLErkenwell 5937 Grams: DAUNTING LONDON

Metal Finishers



METAL INDUSTRY

FOUNDED 1909

EDITOR: L. G. BERESFORD, B.Sc., F.I.M.

15 MAY 1959 VOLUME 94 NUMBER 20

CONTENTS

PUBLISHED EVERY FRIDAY BY ILIFFE & SONS LIMITED

Editorial Offices: 9 Charlotte Street, Birmingham 3 . Telephone: Central 3206

Advertising and Publishing Offices: Dorset House, Stamford Street, London, S.E.1. Tel.: Waterloo 3333. 'Grams: "Metustry, Sedist, London"

Branch Offices: MANCHESTER: 260 DEANSGATE, 3; telephone, Blackfriars 4412 and Deansgate 3595. BIRMINGHAM: KING EDWARD HOUSE, NEW STREET, 2; telephone, Midland 7191. COVENTRY: 8-10 CORPORATION STREET; telephone, Coventry 25210. GLASGOW: 26a RENFIELD STREET, C2; telephone, Central 1265

ANNUAL SUBSCRIPTION

HOME **£3 7s. 6d.** *OVERSEAS* **£3 12s. 0d.** *CANADA AND U.S.A.* **$10.00**

INCLUDING ONE COPY OF **METAL INDUSTRY HANDBOOK,** *PUBLISHED ANNUALLY*

By the Highest Standards

Performance at the upper levels of many human pursuits calls for exceptional qualities of mind and body. In evaluating these feats, the judgment should be on a similar plane—exacting—discriminating—entirely objective — conforming to the highest standards with no compromise.

Without integrity a standard is valueless, for then there is no dependability to inspire confidence in its use. This is valid, not only for abstract but also for material standards, and the high reputation enjoyed by the British Standards Institution has been built on firm, authoritative specifications commanding general respect.

Selection of a proprietary product as the basis for a British Standard is a noteworthy distinction which was granted to MAZAK when its production specification was accepted for B.S. 1004.
(Zinc Alloys for Die Casting).

MAZAK

The Standard by which others are judged

CONSOLIDATED ZINC CORPORATION (SALES) LIMITED, 37 DOVER STREET, LONDON W.1.

METAL INDUSTRY

VOLUME 94 NUMBER 20 15 MAY 1959

Self-Help

GRANT-AIDED research organizations in the Government scheme serve about 55 per cent of British manufacturing industry and perform a wide range of functions. Of these functions, the largest single item is applied research on problems common to each industry served. By paying the "block" grant, the Department of Scientific and Industrial Research can ensure that each association has the necessary proportion of basic research in its programme, that research results are freely available to Government departments, and that there is no undesirable overlapping of projects. In 1955, an allowance was made to restore the real value of the grants, in accordance with changes in the purchasing power of money, and the Industrial Grants Committee have recommended a similar position, if necessary, for the period of the second five-year plan. They also suggest that research associations should be encouraged to do a reasonable amount of sponsored research, holding that it strengthens the contacts between research associations and industry, and that the payments add to total income and help to spread the cost of research equipment. In future, therefore, a grant-aided association can undertake sponsored projects provided the income arising from them does not exceed 15 per cent of the total income in any year, and that the cost of any one project does not exceed £5,000.

The very fact that a survey of the work of the research associations was undertaken by the Industrial Grants Committee last year inclined some to conclude with Marcellus that "something is rotten in the state of Denmark." On the contrary, their recently-issued report shows that this is definitely not the case. For, as the Committee state, "co-operative research brings important benefits to those taking part. It economizes on money and manpower. It offers a scientific service to firms that cannot afford research departments of their own. It helps to guide industry towards an appreciation of the value of research in general. It facilitates an exchange of technical information and other forms of mutual assistance. Finally, it builds a store of knowledge on which the nation, through Government departments, can draw."

Of none are these words more true than of our own non-ferrous metals research association, which this week threw open its new laboratories for inspection. First opened in 1930, plans for expansion were laid as long ago as 1937, at a time when the Association had only 250 members and the total income was less than £30,000 per annum. These plans have now been finally completed, adding another 12,500 ft^2 of floor space to the laboratories and bringing the total to about 53,000 ft^2. The new block contains corrosion laboratories, a large metal finishing shop, extensions to the physics laboratories, and the foundry. This and other rearrangements and improvements will allow for a future expansion of about 20 per cent in most sections, as well as providing some free space for short-term projects. The total cost of these extensions is estimated to be about £125,000, of which £85,000 has already been received and another £20,000 has been promised for 1959, thus leaving £20,000 to be found.

With a present membership of 630, total revenue in 1958 from all sources was £194,000, grant-earning subscriptions being £103,000. For the second year in succession the minimum grant-earning income — namely, £100,000 — was reached only because certain extra amounts, totalling £6,000, were contributed by members during the year to accelerate the progress of particular researches. Considering the value that is received, it is amazing that some firms who could well profit therefrom are still not members of the Association, and it is to be hoped that, seeing the errors of their ways, they will lighten the task of the Council of ensuring that the minimum regular grant-earning income is achieved in 1959.

Out of the
MELTING POT

Another Instance

PRODUCTION of composite materials and products by a process involving the electro-deposition of one of the constituents is by no means new, but certainly a still very much neglected branch of the art and science of electroplating or electroforming. An opportunity of once again bringing up this subject is provided by a description of an apparatus developed for using electroplating for the production of abrasive tools, in particular continuous abrasive belts. The apparatus consists of an electroplating tank in which is immersed a framework carrying two pulleys, one driven and one idler, arranged with their axes lying in a horizontal plane. A belt of stainless steel is mounted on the pulleys. The edges of the belt and its inner surface which comes into contact with pulleys are coated with an insulating varnish, which thus leaves an uncoated portion only on the outer surface of the belt, on which metal can be deposited from the bath when the stainless steel belt is connected as the cathode. The drawbacks of a sliding contact to the belt are avoided by mounting the pulleys on stub axles, which enables contact to be made with the belt through a flexible wire lead which is fixed to the belt and moves with it. Anodes of the required metal are suspended in the bath in the usual way. The abrasive material, e.g. diamond dust, which is to be incorporated into the electroformed belt, is fed from a hopper and distributed over the exposed outer surface at one end of the upper run of the stainless steel belt. The particles of abrasive become bonded by the electrodeposited metal. Any excess or still unbonded abrasive falls away as the belt passes downwards over the pulley, and is collected for subsequent use. The proportion and distribution of the abrasive in the deposit and the thickness of the deposit can, of course, be varied by controlling the operating variables. Once the desired deposit has been formed, the stainless steel belt is removed from the pulleys and the deposit is stripped from it. The endless band obtained in this way can be used for abrasive band cutting. Alternatively, by suitable masking of the stainless steel belt, the apparatus can be used to produce a number of separate abrasive shapes such as discs, etc. By varying the nature of the material fed on to the belt, the use of the above apparatus could, of course, be extended to the production of bearing materials, friction materials, and . . . . Any other ideas?

Too Simple

ONLY by deviating from the lines along which knowledge is being pursued does one realize how little is really known about materials in general and metals and alloys in particular. The cause is not far to seek: in the absence of the incentive of foreseeable practical applications, mere curiosity (fundamental research) or a liking for tidiness and a dislike of loose ends would appear to provide very inadequate stimuli. All these generalizations are admirably illustrated by the particular case of intermetallic compounds. They have suffered very badly, first from being objects of academic interest and, more recently, of advanced interest. Not so long ago, interest in most of them was as materials, the composition of which happened to accord with certain simple arithmetical calculations. Of late, the magic term semi-conductor has sparked off an interest that has led to an examination of numerous compounds, the very existence of which had previously gone unnoticed, but an examination from that particular narrow point of view only. Apart from the fact that they are brittle and, therefore, useless for practical purposes, intermetallic compounds as common or even laboratory materials are still a closed book, an uncharted field, or an unfilled table of properties so far as the average metallurgist is concerned. Exceptions there have been. In general, however, a general-interest approach to intermetallic compounds as to what, after all, could be ordinary materials, still encounters all the evidence, mentioned above, of a lack of ordinary interest in them. The situation is even worse should one try to follow up the apparently still extraordinary idea that among the intermetallic compounds there might be one or two with certain simple properties (if only somebody had been systematic enough to determine them for no better reason than that they obviously exist) that would fit them for some given simple job.

Outlook

OVER-LONG accounts of the present state of some "art" with concluding remarks on its future potentialities are always a little unsatisfying. Take honeycomb sandwich construction, for example. The mere fact that any account of it must be long, indicates that it is more of an art or skill than a production process. One cannot escape the impression that here, using the latest light-gauge, high-strength sheet and foil, the latest high-temperature-resisting synthetic resin adhesives, and ultrasonic methods to check on the soundness of the conglomerations, one has the modern counterpart of that earlier art in the self-same field of aircraft construction by which art, now lost, special high-grade timber structural elements were pared down to the last possible fraction of an inch, glued together, and covered with fabric and "dope," to yield structures which, in their own particular field and for their own particular properties, have never been surpassed. That art is now lost or, at any rate, its creations, like the creations of the builders of the Egyptian Pyramids or of the massive mortar-less stone structures of ancient Peru, are no longer in demand. Like its predecessors, the art of honeycomb sandwich construction, for what it sets out to be and do, is irreplaceable. Like its predecessors, it calls for a high cost in human endeavour. And one feels that, like its predecessors, it will one day find itself superseded by something else, and unwanted. It may yet have a future, limited by the introduction of silicone resins and the like, for higher temperature service, and in due course of ceramic honeycombs and ceramic binders for still higher temperature service, but a future nevertheless limited, and one that does not include the prospect of a change-over to a common everyday material and techniques for use in some of the fields and applications that are now optimistically being suggested.

Skimmer

RUSSIAN WORK WITH INDUCTION HEATED METAL SPRAYING PISTOL

High Frequency Metallizing

By A. P. VLASOV

HIGH frequency metallizing is one of the newer methods of metal spraying. The main difference between this process and other methods of metallizing is that high frequency induction heating is used for melting the metal.

This process was first used in practice in the Soviet Union in 1953, when a practical high frequency metallizing gun, MB4-1, was developed. Further work on improving this gun resulted in the production of the MB4-2 model, a commercial form of gun (Fig. 1). The very first experiments with this gun on the building-up of worn parts by high frequency metallizing showed that the sprayed metal had a high wear resistance and ensured excellent performance of the repaired machine parts.

To determine optimum spraying conditions, special investigations were carried out for the purpose of studying the mechanism of the formation of the metal spray air jet and in order to determine the mechanical and physical properties of the deposited metal obtained by high frequency metallizing using a carbon steel wire.

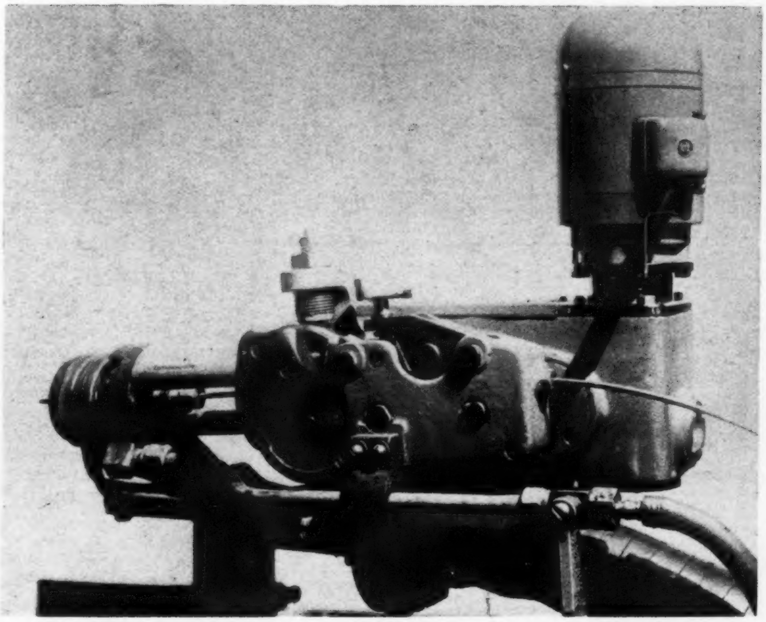


Fig. 1—The MB4-2 commercial high frequency metal spraying gun

The mechanism of the formation of the metal particles in high frequency metallizing, and the operation of the spray head of the gun, can be explained by reference to Fig. 2.

The induction coil (A) of the spray head is supplied with current of a frequency of 300-500 kc/sec. from an ordinary valve generator as used for metal induction hardening. The presence of the field-concentrating insert (C) ensures the maximum intensity of the electromagnetic high frequency field in the region of the spray nozzle. The continuous feed of the wire (B) into the spray head is effected by the feed mechanism (D) via the feed nozzle (E).

The surface layers of metal which melt progressively under the action of the high frequency heating are carried away by the compressed air jet, which enters through the channel (F) under a pressure of 2 to 5 kg/cm^2, and which concentrically surrounds the end of the wire.

This method of melting and atomizing the metal ensures a sufficiently high uniformity of the spraying process being achieved. Investigations have shown that, depending on the air pressure, the greater part of the metal is atomized into particles of from 100-120 to 20-30 microns. Particles of steel obtained with an air pressure of 4 kg/cm^2 are shown in Fig. 3.

The speed of flight of the particles varies in a complicated fashion. The characteristic curves giving the change in the mean speed of the steel particles with increasing distance from the gun for different pressures of the compressed air supply are given in Fig. 4.

Fig. 2—Diagram of the spray head of the high frequency metallizing gun

A—Induction coil. B—Wire being melted. C—Concentrating insert. D—Feed mechanism. E—Feed nozzle. F—Air channel

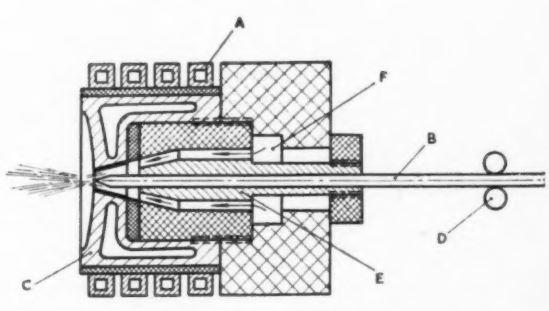
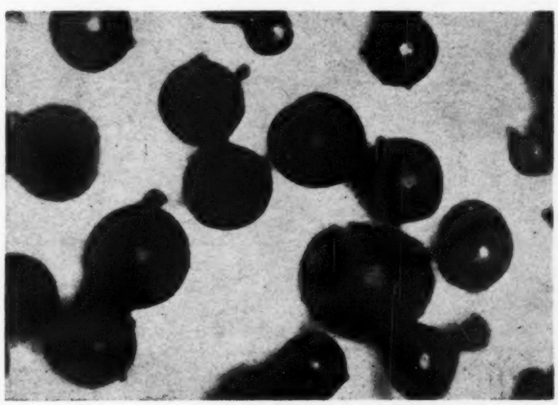
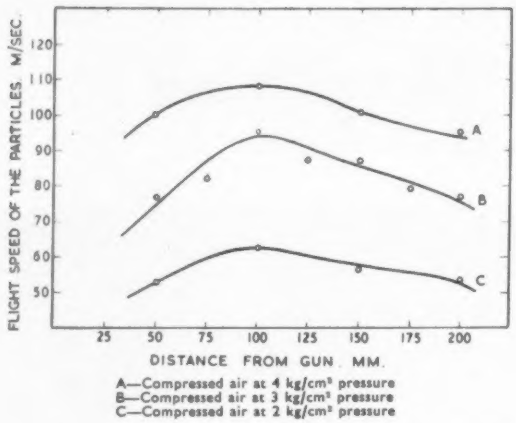
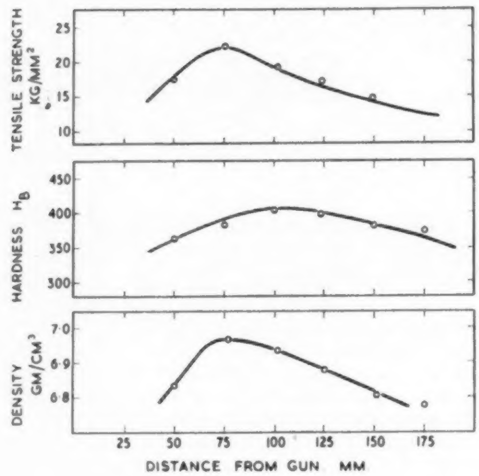


Fig. 3—Particles of steel obtained with an air pressure of 4 kg/cm²







Above left: Fig. 4—Variation of the mean speed of flight of the metal particles with distance from the gun

Left: Fig. 5—Change in temperature of steel particles with distance from gun

Right: Fig. 8—Variation of properties of the coating with distance from the gun

These curves indicate that the particles reach maximum speeds at a distance of about 100 mm. from the gun, this maximum speed in the case of steel being 65 m/sec. (for an air pressure of 2 kg/cm^2) and up to 130 m/sec. (for an air pressure of 5 kg/cm^2).

The curve (Fig. 5), illustrating the change in temperature of the steel particles with increasing distance from the gun, shows that this temperature falls off gradually with distance. Measurements made with a radiation pyrometer to determine the average temperature of the steel particles in the spray at a distance of 100 mm. from the gun, gave a mean value of about 1,200°C. Further investigations suggested, however, that in all probability the actual temperature of the particles is somewhat higher than that measured with the pyrometer.

It was thus established that in high frequency metallizing, the particles of metal reach the surface to be coated with a sufficient reserve of kinetic energy and in a highly plastic state, whereby favourable conditions for the formation of a dense coating of good quality are ensured.

Bonding of the particles among themselves in the sprayed coating is favoured by the fact that, in induction metallizing, oxidation of the metal is considerably reduced. The oxide films formed round the particles of metal are thin and unstable. When the particles impinge on the surface being coated, the oxide films are partly destroyed, with the result that at some points direct metallic contact is obtained. The instability of the oxide films is also confirmed by the fact that on heating to 900°-1,000°C. they readily break up and coagulate into isolated inclusions. This phenomenon suggests other investigations designed to improve the quality of the sprayed metal coatings. The structure of a sprayed steel coating obtained by high frequency metallizing before and after heat-treatment of the specimens is shown in Figs. 6 and 7.

Fig. 6—Unetched section; distance from gun 75 mm.; air pressure 3·5 kg/cm². (× 350)

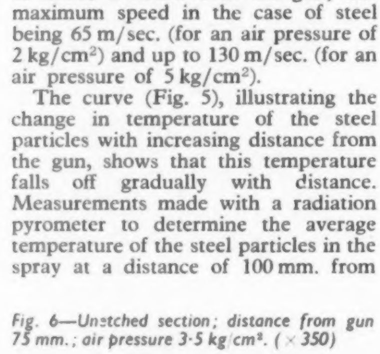
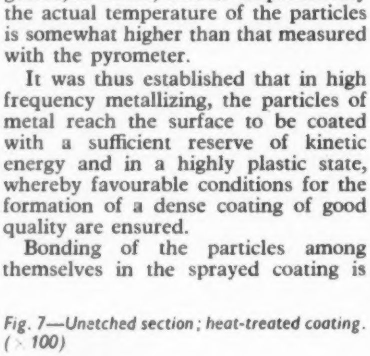


Fig. 7—Unetched section; heat-treated coating. (× 100)



The important advantage of the high frequency metallizing process is the fact that loss of alloying constituents during the melting of the metal is considerably reduced. Thus, for example, where the sprayed wire had a carbon content of 0·45 per cent, the carbon content of the sprayed coating was still as high as 0·42 to 0·43 per cent. Similarly, the manganese content changed from 0·65 to 0·59-0·61 per cent. In manganese-silicon steels, the silicon and manganese content changed on the average from 1-1·05 to 0·9-0·95 per cent. A comparison with arc metallizing shows that the oxide content of the high frequency sprayed coating is only 0·25 to 0·2, and the loss of alloying constituents is reduced to 0·2 to 0·125.

Determination of the mechanical and physical properties of a coating obtained by high frequency metal spraying, using a steel wire of medium carbon content, showed the advantages of this process over other processes in regard to a number of these properties. Some of the results obtained in these investigations are given below.

The mechanical properties of the sprayed metal are as follows: tensile strength about 23 kg/mm^2 (material sprayed—steel St.45) and compressive

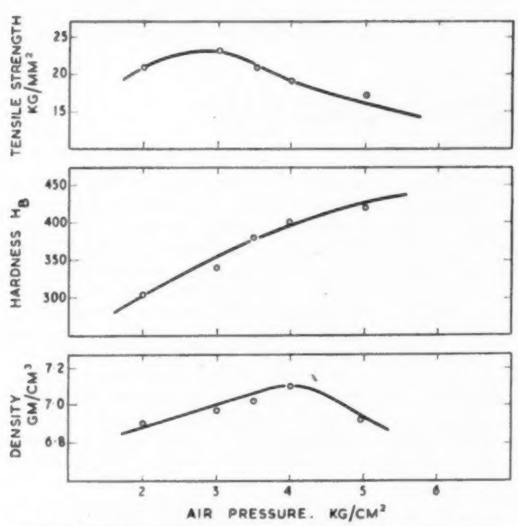


Fig. 9—Variation of properties of the coating with change in air line pressure

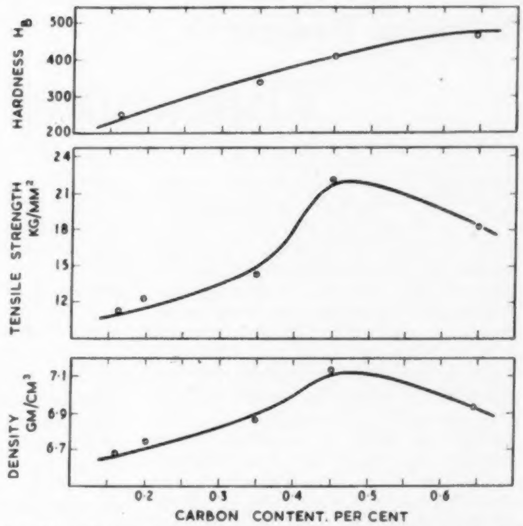


Fig. 10—Influence of carbon content of the wire on some mechanical and physical properties of the coating

strength 90-100 kg/mm². In some cases these values may rise to 27-28 kg/mm² and 120-125 kg/mm² respectively.

In comparison with values obtained in other metal spraying processes, those obtained in high frequency metallizing are not inferior to those in gas-flame metal spraying, and superior to those obtained by arc spraying.

Owing to the reduced loss of alloying constituents and the favourable conditions of formation of the coating, the high frequency metallizing process ensures, for one and the same composition of the wire sprayed, the production of coatings having hardness values at least 150 Brinell units above those obtained by other metal spraying processes. Thus, for example, when spraying a steel wire with a 0·45 per cent carbon content, the surface hardness of the coating attains 400-420 Brinell. A characteristic feature is the small scatter of the hardness values obtained on measuring at one and the same depth in the sprayed coating. In the experiments carried out this scatter was at most 4-5 Rockwell C units.

The sprayed metal has a relatively high density. Under normal conditions of spraying, the density of the coatings obtained using 0·45-0·65 per cent carbon steel wire is seldom less than 6·8-6·9 gm/cm².

The properties of the sprayed metal vary with the conditions of spraying, in particular depending on the distance between the gun and the surface being sprayed, and the pressure of the compressed air supply. These variations are illustrated in Figs. 8 and 9. In Fig. 10, the influence of the carbon content on the above properties of the sprayed metal coating is shown.

In spite of the relatively high density, the sprayed metal possesses an adequate microcapillary porosity. The high hardness, in conjunction with this microcapillary porosity, ensures good sliding characteristics and a high wear resistance of the coating. Thus, for example, the coefficient of friction in the sliding of sprayed steel on leaded bronze, under a pressure of 100 kg/cm² at a speed of sliding of 7·14 m/sec. and with drip lubrication (15 drops/min.) was only 0·0075-0·009 (Fig. 11). The wear of a test specimen coated with steel St.45 in sliding on cast iron, was found under these conditions to be

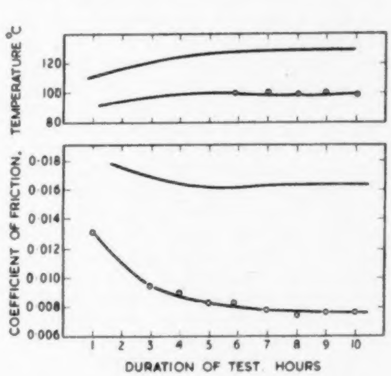
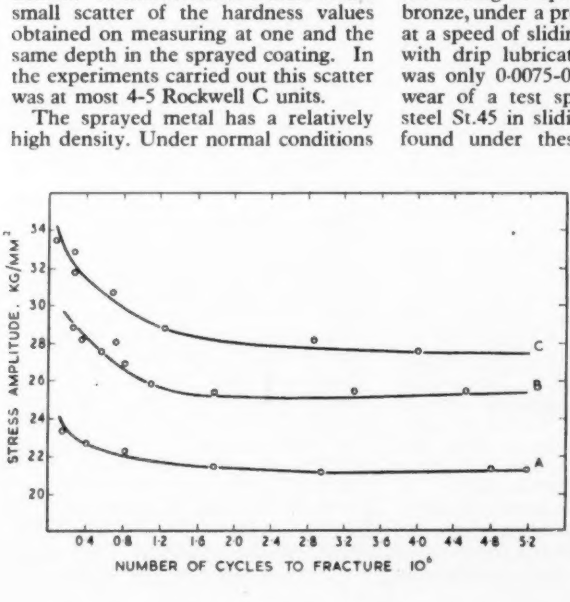


Fig. 11—Comparative friction and wear tests with sliding of test specimens on leaded bronze. The upper line in each diagram represents steel rings and the lower line represents rings metallized with steel; bearing pressure 100 kg/cm², sliding speed—7·14 m/sec.

80 per cent less than the wear of a cast iron test specimen sliding on cast iron.

The fatigue strength of a machine part is not reduced by high frequency metallizing. On the contrary, such metallizing, together with a suitable preparation of the surface of the part (e.g. preparation of the surface by knurling) can result in a marked increase in the fatigue strength of the part. In the case of the test specimens investigated, the increase in fatigue strength averaged 30-35 per cent (Fig. 12).

As compared with arc metal spraying, high frequency metallizing results in a substantial saving in metal due to the lower losses of metal on metallizing, the production of coatings having uniform thickness, and the possibility of using inexpensive types of wire of medium carbon content, which ensure the production of good quality wear-resistant coatings.



A—Untreated test specimen. B—Knurled test specimen. C—Knurled and metallized test specimen

Fig 12—Fatigue curves (Wöhler curves) obtained in comparative tests

Atomic Progress

Thermal Cycling Damage

FUEL elements for the first commercial nuclear power stations under construction in this country are designed to operate with the maximum fuel temperatures within the alpha range. Various transient conditions may be visualized which would cause a temporary rise in the maximum fuel temperature, such that in a few fuel elements the maximum uranium temperature would be cycled through the alpha-beta transition. In this article, the effects of thermal cycling metallic uranium fuel bars through phase transitions are considered, and special attention is devoted to effects which arise from alpha-beta thermal cycling.

McIntosh and Heal[1] describe tests in which unconstrained specimens were cycled between temperatures 25°C. above the heating and 23°C. below the cooling transition temperatures. Buckley[2] *et al* carried out thermal cycling tests between similar temperatures but under controlled gradients. Diameter or length changes are plotted versus number of cycles by these authors. The graphs indicate a linear dimension change with increase in the number of cycles. In some cases, the linear part of the graph is preceded by an induction period of up to 50 cycles, during which the material is relatively stable and shows little change as a result of the thermal cycling. Buckley *et al* found this induction period characteristic of worked uranium specimens, and Heal and McIntosh show this type of behaviour with several alloys. Dimensional stability increases slightly with the concentration of aluminium in uranium-aluminium alloys,[1] possibly due to the increased amounts of UAl_2 precipitate. Duplicate specimens of a uranium-2 per cent vanadium alloy showed interesting differences, namely, one containing a coarse acicular precipitate, believed to be nitride, was more stable than one which did not contain this precipitate. Chromium (0·75-1·0 per cent wt.) and molybdenum (0·1-7·6 per cent wt.) additions confer resistance to damage, such that little damage occurs after 100 cycles.[2] Alloys containing 4·7 per cent wt. or more molybdenum were completely stable. Silver, zirconium, titanium and iron additions do not seem to affect the stability significantly.

The behaviour of uranium graphite cermets prepared by compacting and sintering graphite-coated uranium powder is interesting. The structure comprises uranium particles partially or completely surrounded by carbide. Most of the growth is arrested by 1 per cent graphite. With 2 wt. per cent graphite the growth is eliminated and replaced by isotropic swelling, and at 3 wt. per cent graphite the carbide network is complete and of sufficient mechanical strength to restrain swelling, and little damage occurs until the carbide begins to spheroidize after about 100 cycles.

Void Formation

Alpha-beta thermal cycling leads to considerable porosity. Buckley *et al* show data on the density decrease for a variety of uranic products, which can be as much as 3·0 per cent after about 70 cycles. The holes are of rounded form and generally distributed through the material.

Theory

Buckley *et al* assume that the plastic flow which occurs during a single alpha-beta-alpha cycle depends on (1) the transformation volume change, (2) the relative strength of the two phases, and (3) the direction and shape of the phase interface. A volumetric dilation of about 1 per cent occurs as a result of the alpha-beta transition. In a sample of uranium, alpha phase zones join beta phase zones across coherent interfaces, causing equal and opposite stress systems. There will be tensile stresses in the alpha phase and compressive stresses in the beta phase parallel in direction to the plane of the interface. Plastic relaxation of a cubic volume of alpha phase will cause the cube to contract in a direction perpendicular to the interface and expand in a direction parallel to it. Relaxation of a similar beta phase cube leads to contractions in the plane of the interface and elongations perpendicular to it. Buckley *et al* note that the hardness of beta uranium is greater than that of alpha uranium, and conclude that stress relaxation will occur predominantly in the latter. Thus, the overall change in shape results from the faster relaxation rate of the alpha phase, giving larger contractions of alpha-phase elements than elongations of corresponding beta-phase elements. Growth is independent of the direction of the phase change.

Heal and McIntosh do not consider the volume changes which occur during the alpha-beta transition large enough on their own to explain the observed differences in thermal cycling behaviour of the alloys they examined. These authors consider the tensile properties of magnesium-reduced uranium, a uranium −2 at. per cent vanadium alloy, a uranium −½ at. per cent chromium alloy, and a uranium −4 at. per cent molybdenum alloy. In the case of the magnesium-reduced uranium and the vanadium alloys, the beta phase is 2-3 times stronger than the alpha phase and considerable damage was observed in the thermal cycling tests. In the case of the chromium alloy, there is little difference in the relative strengths of the two phases, and the amount of thermal cycling damage observed was small. In the temperature range studied the molybdenum alloy always contained two phases, $\beta+\gamma$ above 658°C. and $\alpha+\gamma$ below 658°C., and there were no abrupt changes in tensile properties associated with this transition. Here, the amount of thermal cycling damage observed is very small. This evidence supports the theory advanced by Buckley *et al*, and indicates that the extent of permanent distortion on repeated alpha/beta cycling is related to the relative strengths of the two phases.

The detailed changes in shape are complicated by transitory effects at the onset of transformation, by end effects, and by incomplete transformation. Uncertainties as to the stress fields away from the interface complicate calculation of the theoretical rate of thermal cycling growth.

The mechanism of void swelling is believed to be similar to that proposed for shape changes. Existing voids will contract or expand according to whether they are in compressed (β-phase) regions or expanded (α-phase) regions of the interface. Differences in plasticity of the two allotropic modifications will thus give rise either to swelling or to compacting, as well as to a shape change. The origin of void nuclei is uncertain. Progressive cyclic hardening followed by lattice breakdown seems unlikely, as no hardness changes have been detected as a result of cycling. Similarly, it is unlikely that nuclei form as a result of grain boundary flow, as in creep, because the grain structure changes after each transformation. The most likely explanation is that thermal ratcheting occurs at stable interfaces, i.e. at insoluble inclusions such as uranium oxide and carbide.

Effects on Fuel Elements

In fuel rods the transformation will be initiated internally and, as the temperature rises, the beta phase zone expands in the direction of heat flow towards the outer surface. Buckley *et al* consider three stages in this process. In the first stage, the transformation expansion of small beta-phase nuclei is restrained by elastic stresses in the surrounding alpha-phase matrix. Calculation of the stress field due to concentric cylinders of alpha and beta phases shows that about one-fifth of the diameter of an unclad cylindrical fuel element may transform to beta before

(*Continued on page* 400)

Finishing Supplement

Treatment of Aluminium

ANNUAL CONFERENCE OF THE INSTITUTE OF METAL FINISHING

MEETING at Brighton, the Institute of Metal Finishing held its annual conference during the period April 8-11, the technical sessions being held in the Clarence Room of the Metropole Hotel. The first of these sessions, under the chairmanship of **Dr. T. P. Hoar,** opened with two Papers on the subject "Treatment of Aluminium," of which abstracts appear below. Contributions to the discussion were read by the President, and a report of these follows the relevant abstract.

The Production of Coloured Anodic Films Without the Use of Dyestuffs

By J. M. KAPE and E. C. MILLS

CERTAIN inorganic colouring agents are extremely fast to light and weathering. Some of these colours are, admittedly, not so easily obtained as those given by dyestuffs, and will naturally be more expensive, but others compare favourably in cost and ease of production with dyed anodic films.

The main part of the Paper concerns the colours produced by inorganic pigments, and it is considered that the mechanism of their production is different from dyestuffs. The formation of a coloured anodic film is dependent on the absorption of ions, first from one of the reagents and then from the other. The intensity of colour of a compound and subsequent colour-matching from one batch of work to another so produced, is dependent on many factors, of which the conditions of anodizing are very important. In order to obtain results which are reproducible from one batch of work to another, it is essential to have accurate control over all variables from pre-treatment of the work to the final sealing operation. It is concluded that satisfactory production of large architectural components coloured by these inorganic pigments is dependent to a large extent on the acceptance of new and accurate methods of production anodizing.

A few of the inorganic pigments have already been extensively exploited in the U.S.A. and on the Continent for outdoor decorative purposes. Long-term outdoor application of the ferric oxide colour produced by ferric ammonium oxalate, a grey shade produced by anodizing 5 per cent silicon alloy, and the cobalt oxide bronze colour, have been satisfactory.

It may be concluded from the present work that certain of the other inorganic pigments show promise as durable colours for outdoor exposure. These are the green copper sulphide, the yellow lead chromate, and the prussian blue type colours when sealed in dichromate solutions. Other pigments which are promising are the selenium sulphide orange and the light brown shade afforded by bismuth sulphide.

The colour afforded by dichromate sealing has often been used for decorative outdoor purposes, and the durability of the finish is confirmed.

It is evident from the results of the outdoor exposure tests that the life of anodized architectural components will be considerably lengthened by regular cleaning—about once a month would be necessary for components exposed to an industrial atmosphere.

(*Trans. Inst. Met. Finishing*, 1958, **35**, *Advance Copy*)

DISCUSSION

F. C. Porter (Aluminium Development Association), in a written communication read by the President (Dr. T. P. Hoar), referred to Table V of the Paper, which mentioned some pigments that broke down at elevated temperatures, and asked whether data were available on the heat-fastness of the other pigments. There appeared, he suggested, to be no justification for the straight line in Fig. 1. Above pH 4·5 the evidence indicated, as might be expected, a uniform change of weight. The authors brought out an important point in Fig. 2, where they showed that for the chosen dyeing conditions a long drying time (greater than 20 min. or 4 cycles) gave almost uniform pigment absorption, which facilitated colour matching between batches.

From Table II it appeared that the penetration of B3LW red dye changed from "⅓-½" to "throughout" with little change in the weight of the dye absorbed. Did this indicate some disintegration of the anodic film?

The deleterious effect of lead-base pigments under salt-dip conditions was not surprising, but harmful effects would also be expected from the copper-base pigments. The authors' comments on this would be welcome.

Finally, had all the anodizing and pigmenting processes been carried out in distilled or deionized water?

J. M. Kape (Alumilite and Alzak Ltd.), replying, said that so far as heat-fastness was concerned the authors had examined only the colours dealt with in Table V. The ferrocyanides were inherently unstable towards heat; the oxides would not change a great deal, but there might be a change of shade; the chromates were unchanged by heat and the sulphides would be oxidized or completely bleached. He agreed with the comment on Fig. 1 The line was drawn as a broken line, showing an escapist attitude, but it was the best that could be drawn through the points.

The long drying time was an important point, and he was glad that it had been brought out. It would help a great deal to control colour matching from batch to batch.

The authors would not associate penetration of the dye with the disintegration of the anodic film; that the weight tended to be constant after a long dyeing time would be due rather, they thought, to the absolute saturation of dye in the film.

As for the copper-base pigments in salt-dip tests, both the copper sulphide and the copper ferrocyanide were very insoluble in water; their solubility might be regarded as negligible, whereas the lead compounds, the lead oxide and the lead sulphide, had a relatively high solubility, which probably accounted for their corrosive action. The experiments were to produce the colours for architectural panels and were all carried out in distilled water, but further work had indicated that for the jobbing anodizing type of work ordinary mains water would suffice.

A. W. Brace (Aluminium Laboratories Ltd.) regarded the practical difficulties as the key to the value of the Paper. Did the authors feel it was possible with some of these colours to get good colour matching if adequate attention was paid to the control of temperature, concentration, and, in particular, the duration of rinsing between the intermediate dips? He had found the cobalt oxide-permanganate one was easy to work. Did the authors regard the ferro-chromium oxalate plus pyrogallol single dip as a reasonable process and one which gave a colour of good light fastness? Did they see any possibility of any further single-dip treatments of ferro-chromium oxalate being devised? They had such obvious attractions compared with double dip that every anodizer would prefer them.

Mr. Brace's organization had carried out weathering tests with a number of the pigments that the authors had produced, producing them separately in their own laboratory, and they could confirm several of the authors' findings and add an additional one. They had examined a red-brown colour produced by dipping in lead nitrate and potassium permanganate over three years' exposure, and that had a rating of 4 on the B.S. Grey Scale.

In connection with the sulphides, he made the point that it was very difficult to get rid completely of traces of sulphide from the surface, even when the coating was sealed, and that was liable to give a white oxidation product on weathering which looked unsightly. That should be borne in mind in considering the application of sulphides to such operations.

J. M. Sprague (Consulting Electro-Chemist) asked whether the authors had

INSTITUTE OF METAL FINISHING ANNUAL CONFERENCE

Some of those attending the Annual Conference of the Institute of Metal Finishing, which was held at Brighton recently, are shown in the illustrations below.

Mr. D. Powell, Mr. W. R. Laban, Mr. R. A. Wilding, Mr. E. Marlow, Mr. J. H. Kimberley, Mr. J. Dixon, Mr. E. L. Masek

Mr. M. L. Alkan, Dr. W. R. Meyer, Mr. J. Bechtold

Mr. N. Gross, Mr. E. J. Blewett, Mr. J. W. Weaver, Mr. E. Bishop, Mr. P. A. Cartwright

Mr. E. Podmore, Mr. B. E. Love, Mr. R. W. Pittaway, Mr. T. Wright, Mr. R. G. Hughes

Above left : Mr. R. B. Olliver, Mr. J. M. Sprague, Dr. M. L. Becker

Above right : Mr. M. L. Alkan, Mr. J. Oswald, Mr. J. Bechtold, Mr. D. T. Chambaud, Mr. de Rudder, Mr. M. Massard, Mr. P. Morisset

Left : Dr. and Mrs. F. A. Champion, Mr. R. Slingsby, Mr. T. I. Williams, Mr. and Mrs. Marlow, Miss Marlow, Mr. J. Plant

Bottom left : Mr. S. A. Watson, Mr. H. C. Castell, Mr. S. C. Britton, Mr. G. N. Flint

Bottom right : Mr. E. W. Methley, Dr. Shreir, Mr. and Mrs. B. B. Tully, Mr. L. Eyers, Mr. E. Gaiger

considered having an innocuous material such as glue, giving no colour, in some of their solutions. That might have two effects: it would reduce the particle size, and quite usefully affect the colour, and by reducing the particle size the particles might be precipitated more thoroughly throughout the pores of the anodized coating, giving a deeper and more permanent colour.

The authors referred to the use of chemical polishing in the preparation of certain samples, and he wondered if it was going to be used, why it had not been used much more widely?

E. C. Mills (Research Division, High Duty Alloys Ltd.) gave some information about the performance of the dyes over a longer period than that dealt with in the Paper, where the maximum time was about nine months. Towards the end of the Paper the authors gave a list of the colours which were considered to be good after nine months. Taking these, the lead chromate colour had remained good over the two-year exposure period, and so far as fading was concerned it still rated at about 5-4 on the Grey Scale. The cobalt oxide series had also stood up extremely well: there was a certain amount of fading, but the colour was very good in all cases. The copper sulphide series was also standing up quite well. In one case in the NS.4 there was a slight fading, down to a contrast 4-3, but the quality of the colour was still present and the surface was still extremely good. In regard to what Mr. Brace had said about sulphides, the authors had not noticed any whitening or discoloration of the surface at all with these pigments. The iron oxide ones had stood up quite well, as would be expected and this was also true of the self-coloured dichromate sealed anodic coatings. If anything there had been a tendency to darken in this case, but the colour was still strong.

Coming to the second group, they had to record something which differed from what they had expected. The bismuth sulphide one on outdoor exposure, NS.4, had faded from contrast 3 to contrast 2 over the two-year period, although in the weatherometer this pigment had stood up very well indeed. The selenium sulphide series had behaved quite well, although (as might have been expected from a knowledge of the metallic element selenium) they were tending to become more brown or more red, and there was a slight tendency for discrete particles to come out through the film. The general appearance was quite nice, but more experimental work would have to be done to verify the suitability of selenium. The whole of the prussian blue family, including things not officially called prussian blue, stood up very well indeed, and particularly the S.22, which had faded slightly, from 4 to 3, but it still had tremendous life, and it should be remembered in judging colours, particularly where it was not necessary to match colours exactly, that, even if there was a little fading, if a colour still had life in it it could be put to a lot of use. Films on the 5 per cent silicon alloys were quite remarkable for their stability.

Mr. Sprague asked why chemical polishing had been used in some cases. That had been done merely to get a whole series of panels in a uniform condition to aid comparison.

J. M. Kape, replying to Mr Brace, said they had demonstrated that the practical difficulties could be overcome in production anodizing in the works. They had not much experience of the ferro-chromium oxalate-pyrogallol process. It gave a bronze which would be acceptable if one liked that type of bronze, but the bath was somewhat unstable. There was another single-dip process using Schlippe's salt, which was used in photography, with a gold-containing medium. The immersion of anodized work into that solution gave a yellowish gold colour.

Making Mirrors by Bright Anodizing Pure Aluminium

By J. J. DALE, L. H. ESMORE and I. J. HOWELL

MIRRORS of good quality can be made by bright anodizing super-pure aluminium, provided that material with a suitable structure is chosen, and that great care is exercised in the selection and application of the various stages of processing. Diamond abrasive lapping is to be preferred to buffing as it has a cleaner cutting action, with less surface flow and contamination. An intermediate stage of metal dissolution, prior to final lapping, is most helpful. Electrochemical treatments should be selected with the object of avoiding any chances of etching, and of minimizing the accentuation of the ripple initiated in lapping. A double anodizing treatment is suitable. Treatments involving electropolishing may prove equally satisfactory. The optical comparison methods described should be useful in assessing alternative processes. The quality of the mirrors falls short of that obtained on front-surface aluminized glass and on silver-rhodium plated brass, but they have the advantages of cheapness and durability. It is probable that the magnitude of the ripple is a function of the grain structure of the metal, and it would be less troublesome if finer grain sizes were available in super-pure aluminium.

(*Trans. Inst. Met. Finishing, Advance Copy*)

DISCUSSION

J. M. Kape made reference to the authors' statement that alkaline electropolishing processes left a white film on the surface and said that this could be easily removed by immersion in a chromic acid-phosphoric acid desmudge of much the same composition as the authors' "strip" solution.

It was surprising that the butyl alcohol-phosphoric acid electrobrightening solution had been found to be superior to the alkaline bath in these applications. Experience with this solution and with other, similar phosphoric acid-alcohol mixtures had convinced him that these solutions had a tendency to pit, stain and in particular cause heavy irridescent or white film to be left on the surface, composed of aluminium phosphate. It was essential to remove this in chrome-phosphoric mixtures prior to anodizing. The method described of double anodizing was well known in the trade and was frequently employed to reclaim rejected brightened articles where dimensional tolerances were of importance, so as not to incur re-treatment in a chemical or electropolishing bath.

The authors referred to the anodic film containing a mixture of sulphuric acid and aluminium sulphate and considered that these chemicals, leaching out of the coating during sealing, caused the formation of the characteristic sealing bloom. This was an interesting hypothesis, but bloom formation was perhaps more complex in origin, and the more efficient the sealing, usually the more the bloom. The *p*H of the sealing bath was considered to be an influential factor, and also the purity of the distilled water. Did the authors consider that any one particular *p*H of the water coating bath was of consequence to the formation of the sealing bloom, and had they noted whether bloom reappeared with exposure to the atmosphere during service of the mirrors?

The President (Dr. T. P. Hoar) added that some fairly recent work done at Cambridge on the sealing process seemed to indicate that the bloom in the particular cases with which they had dealt was due more to deposition from the sealing bath, and even to slight decomposition of the surface of the anodized film, rather than to anything leaching out from the pores of the anodized film.

J. J. Dale, in reply, said that for the alkaline solution they had used a well-known proprietary process, but they had not had enough practice with it or time to get good results, and in fact they managed to get a white film which was not removed. On the other hand, they had had a great deal of experience with the butyl alcohol solution, and their position had been the reverse of Mr. Kape's in that they had been able to get very good results with this, with no white film, but they had finally rejected it because it tended to pit, stain and etch. Nearly always, even under the best conditions, there had been a faint background etch. They had done very many test-pieces with that solution, and they had been able to avoid staining trouble, but they could not get away from the etch pattern, and an additional effect was upstanding spots, which might have been due to deficiencies in cleaning, and which were not pits but little bumps. Some of the mirrors done in that way had been almost as good as those produced by double anodizing, but they had standardized on double anodizing because it gave consistently better results. They were aware of the fact that double anodizing was fairly well known, but he did not think that it had ever been described very much or that reflectivity measurements had been done. It had never been put forward as a possible alternative to electrobrightening, and they thought that it was.

On the question of blooming on the final coating, they had done test-tube experiments. When aluminium sulphate was put in water it gave a clear solution, but when it boiled it hydrolized to form a compound which was insoluble. The authors thought that that was probably the reaction which occurred in forming this faint bloom on the surface. It happened in sealing, but it did not come from the sealing bath; they thought that it came out of the film and was due to insufficient rinsing. They pointed out that it was not like rinsing a steel surface, where there was just a film on the surface: the film in this case was quite thick and porous and there was more of a leaching action. Their standard procedure had

been to rinse for as long as they anodized, and that was not always sufficient, and it was doubtful whether all the stuff would be got out of the pores. To remove the last traces they used nitric acid after sealing. They did not worry about *p*H; they used a fresh sealing bath in each case, because they did not want to spoil a mirror for a ha'porth of distilled water. He thought the *p*H was between 5 and 6.

Dr. S. Wernick (Consultant) said he was not clear exactly what was achieved by stripping. What was the mechanism of the process, and how far must stripping proceed to be effective? Looking at the finishing sequence it appeared that about 20 min. of anodizing was equivalent to about ten min. of stripping, which seemed somewhat arbitrary; one would expect the relationship to be a little more critical. The authors had had to produce a surface which was much more critical than any of which there had been experience in this country, and their contribution was extremely valuable.

R. A. F. Hammond (A.R.D.E., Ministry of Supply) remarked that the authors had been striving for perfection and seemed to have come very near to it. It seemed to him that the limiting factor in the perfection which they could achieve was grain, orange peel, ripple or whatever one liked to call it. That seemed to be inseparable from the process of polishing, but in the process of polishing it was obvious from the Paper that the metallurgical properties, and particularly the grain size of the substrate metal, were of critical importance, and what they wanted was a metal with a very fine grain size. He wondered, therefore, whether they had considered using electrodeposited aluminium, which would give them a small grain size. Admittedly it was a very elaborate technique to adopt, but they were out for something very special, and for such a special need it might be worth considering. It would be interesting to hear Mr. Dale's opinion on that point.

A. W. Brace, speaking as one who was associated with a company which tried to produce aluminium for people to anodize, referred to Mr. Dale's remark that he did not have access to a rolling mill where any texture required could be produced at will, and said he only wished that that was possible. They knew how to produce material with good anodizing qualities, but there was a great deal which they and their colleagues in the industry would like to know about it. One of the problems was that the crystal structure of aluminium was anisotropic, and this led to slight differences in the thickness of the anodized film, particularly in the first few seconds. This was very largely the cause of ripple. The problem of the aluminium producer was to control both his grain size and his grain structure.

It was possible to effect an improvement, as the authors had done, by controlling the current density, because the depth depended on the current density used for anodizing. Up to 10 amp/ft^2 the ripple was relatively small, but with 15 amp/ft^2 or more the ripple developed became quite pronounced. He was sorry that the authors had had difficulty with the alkaline process, because electropolishing could also give this effect and the alkaline process gave considerably less trouble in this respect than other processes. It would be interesting to know whether the authors had examined the material carefully to decide whether the ripple did show up after electropolishing or was entirely in anodizing. One would expect a little in the electropolishing and rather more in the anodizing.

J. J. Dale, replying to Dr. Wernick, said he was not sure that he understood the question of what was achieved by stripping. All that they wanted to do was to remove the anodic film, and if that were done it did not matter whether the thing was in the strip for 5, 10 or 15 min. They had given it 10 min. to be on the safe side; probably all the film went in 5 min., but the solution was harmless and a good cleaning solution, so that an extra 5 min. did no harm.

Mr. Hammond had hit the nail on the head, because grain size was the determining factor in the severity of ripple; the smaller the grain size the less the ripple. That was why at the end of the Paper the authors handed the problem back to the metal producers. He believed that the producers were doing as well as they could at the present time, and he did not wish to imply that the authors had been given bad material. It was natural for it to be relatively coarse grained compared, say, to brass.

The authors had not considered electrodeposited aluminium because it was difficult and they had no facilities.

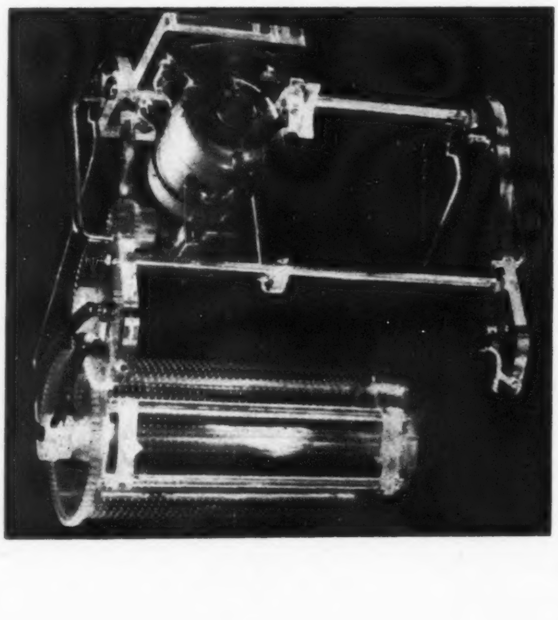
Mr. Brace's remarks about the anisotropic structure were very interesting. Mr. Dale believed that that was the origin of the trouble which the authors had experienced and the genuine origin of the ripple. The Paper showed that with the first method of assessing the ripple there was a bad ripple from electropolishing. That was one of those which had been done commercially, but the authors had confirmed it and said that thickness for thickness electropolishing produced a worse ripple than anodizing. That had been with an acid type of electropolishing, and with the alkaline method the result might have been different, but they had not been able to get that going in time. They regarded anodizing and stripping as a means of electropolishing also, and he still thought that that was so.

Plating Small Parts

MADE from specially treated, abrasion-resistant Perspex, and resistant to all types of pre-cleaning and plating solutions at temperatures up to 80°C., the EPE12 totally-immersed cylindrical plating barrel, introduced by Sonic Engineering and Equipment Ltd., 120-130 Parchmore Road, Thornton Heath, Surrey, can be used effectively throughout the entire cleaning and plating cycle, thus eliminating a great deal of handling. In operation, the barrel is placed on the cathode rod and on one anode rod in the plating tank, and current is fed through leads from the cathode rod connection to cathode contacts inside the barrel. A fractional horsepower motor is mounted at the top of the frame to rotate the barrel.

The barrel is suitably perforated so that the smallest sized parts can be properly processed, and is fitted with a quick release lid for loading and unloading. A high grade polythene version of the unit can be supplied for use with solutions at temperatures above 80°C., such as electroless nickel, while a hexagonal barrel can be provided if required. The overall length of the barrel is 12 in. and the diameter is 6 in., with a recommended process load of 10 lb. to 12 lb. The EPE8, a smaller version, is also available, in which the barrel length is reduced to 8 in.; in each case, the barrel is fitted with tumbling strips. Barrel units can be supplied individually or with whatever types of tank are required.

Parts which can be successfully plated in this type of barrel include safety pins, rivets, nails, all types of screws, bolts, nuts, washers, and other small components. The barrel is also particularly suitable for use in the plating of precious metals.



Totally-immersed cylindrical plating barrel, built in Perspex, and produced by Sonic Engineering and Equipment Ltd.

High Temperature Annealing

The gas-fired bogie hearth annealing furnace at Langley Alloys Ltd., with quenching pit in foreground and (below) the hearth being tilted

REPLACEMENT of an electric furnace which operated at up to 1,250°C., with a stated input of 80 kW, by a gas-fired bogie hearth tilting furnace, has recently been made by Langley Alloys Limited in co-operation with The North Thames Gas Board Industrial Department.

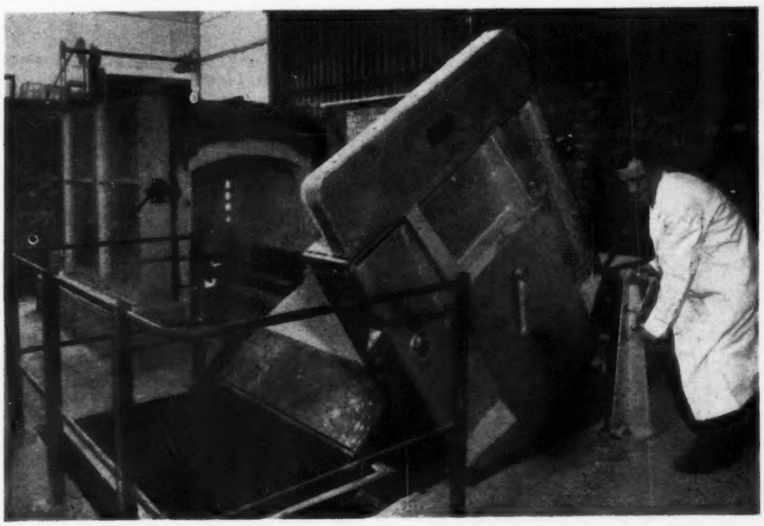
The hearth of the furnace, which is subjected to hard wear and tear through heavy parts being dropped on to it during loading, is designed to tilt when withdrawn so that the articles can be easily tipped into a side quenching tank.

A loading platform in the shape of a steel table at the same height as the bogie hearth together with a quenching tank sunk into the floor completes the arrangement.

The dimensions of the furnace are —door opening 3 ft. 6 in. wide and 1 ft. 11 in. high from the top of the bogie to the spring of the door arch, and a length from door face to back wall of 4 ft. 10½ in.

The casing is designed totally to enclose the brickwork with the exception of the roof and is adequate in strength to prevent any distortion. It is finished in heat resisting aluminium paint.

The articles to be heated are laid on the bogie which has a high quality firebrick top backed with insulating refractory. The door, which in reality forms the back of the bogie, is lined with lightweight insulating refractory and diatomaceous material. Sandseals on the sides and end of the car prevent the hot gases escaping from the furnace chamber on to the undercarriage. The axles of the wheels run in roller bearings reducing to a minimum the effort required to remove the bogie. Clamping screws with hand wheels are provided on the door to lock the bogie in position. An important advantage of having the door built onto the bogie is that the operator is shielded against radiation from the articles on the bogie as it is withdrawn. Withdrawal is executed manually through a chain and bevel gear drive to the wheels, the operating handle being situated at a convenient height on the back of the door. A sufficient length of rail is provided for withdrawing the bogie clear of the mouth of the furnace for loading and unloading.



Heating is accomplished by two air blast burner blocks arranged to fire from the rear wall, along each side of the furnace. There is no flame impingement on the charge and the hot gases, after passing to the door, are drawn back through flues in the rear wall arranged at bogie hearth level. These flues are connected to a common outlet which is damper controlled.

Each set of burners is provided with graduated air and gas control cocks. A motorized valve, wired through a temperature control panel, simultaneously operates valves in the main air and gas supplies according to the heat input requirements.

Other controls on the main gas supply include a constant pressure governor, non-return valve and a solenoid operated main shut-off valve. Air is supplied through an air blowing fan at 22 in. water gauge.

A mild steel loading table is provided with a top for easy loading of the work on to the bogie. As the hearth is at temperature all loading is carried out with tongs.

For depositing the charge in the quench tank there is a tilting device which is hand operated, and here again the door shields the operator from the high temperature as he tilts the bogie. A locking device is included for holding the bogie to the rails as this is being done.

A quench tank 3 ft. wide by 4 ft. 6 in. deep by 5 ft. long is installed and is of suitable size for quenching 500 lb. of castings with a rise in temperature of the water to 140°F.

It is estimated that to heat the furnace and a 500 lb. charge to 1,250°C. would take 3 hr. and require approximately 5,100 ft³ of gas. For a

follow on charge of 500 lb. assuming the furnace to be at 1,150°C. and the bogie at 1,000°C, would take 1 hr. with a gas consumption of 2,300 ft³.

These figures are based on a calorific value for the gas of 500 B.Th.U/ft³.

The safety control consists of diaphragm switches arranged in both air and gas lines and connected to a solenoid valve in the main gas line and which closes, should either the gas or air supply fail for any reason. The solenoid valve cannot be opened until it has been reset by hand.

The furnace is used primarily for the heat-treatment of corrosion resistant castings in the "Langalloy" series of nickel-based and stainless steel alloys, but it is also satisfactory for the hardening and tempering treatment applied to large forgings in aluminium bronze and other copper-based alloys.

Castings in nickel-based alloys which include the nickel-molybdenum-iron and nickel-chrome-molybdenum alloys are given a solution heat-treatment which consists of holding them at temperatures ranging from 1,150°C. to 1,250°C., followed by a water quench or air blast. This treatment ensures maximum corrosion resistance and machinability.

Castings in stainless steels include those made from chromium steels and various grades of chromium-nickel austenitic steels and the heat-treatment consists of water quenching from temperatures of 950°C. to 1,100°C.

Tests were subsequently made during a day's operation to determine the performance of the furnace under normal operating conditions. The working temperature of 1,050°C. was obtained in 1¾ hr. after lighting from cold for gas consumption of approximately 2,500 ft³.

An individual record of each charge was not possible owing to circumstances beyond the control of the observers, but it appeared that the time to recover working temperature following loading was between a quarter and half an hour depending upon the size of the charge.

For one of the charges of 291 lb. of small castings of a nickel based stainless steel the working temperature was recovered in 20 min. for a consumption of 500 ft³ of gas. A further 800 ft³ were consumed whilst one hour's soaking was taking place; making a total of 1,300 ft³ for the treatment of the charge.

Standard Specifications

100° Countersunk Head Steel Rivets for Aircraft (SP.86: 1959). Price 4s. 6d. 100° Countersunk Head High Nickel-Copper Alloy Rivets for Aircraft (SP.87 and SP.88: 1959). Price 4s. 6d.

PREPARED at the request of the aircraft industry, these British Standards "aircraft series" form part of a series for rivets. They specify the material, dimensions, finish and part numbering for 100° countersunk head aircraft rivets in steel and high nickel-copper alloy.

In general, the aim has been to provide ranges of rivets equivalent to those manufactured in accordance with the American specifications AN.426 and AN.427. The rivet heads are controlled by the "flushness tolerance" method and, although they and their shanks have not the same degree of precision as those specified for countersunk head light alloy rivets in British Standards SP.68 to 71, they are more closely controlled than in steel and nickel-copper alloy rivets hitherto used in aircraft.

Copper Sulphate Test and Visual Examination of Hot Dip Galvanized and Sherardized Coatings (B.S.729: 1959). Price 3s.

FIRST published in 1937, B.S.729 provided a standard method of test for hot dip galvanized and sherardized coatings on articles other than wire. In this revision, the range of articles has been specified with size limitations. It includes bolts, nuts, and other threaded articles of similar size; articles fabricated from strips, bars or tubes; and castings, angle brackets and structural shapes.

For larger fabricated articles, and for grey and malleable iron castings, a further standard is in preparation.

The copper sulphate test has not been supplanted; it is now presented in a simplified form. Mention is made in an appendix of electronic thickness gauges, which, whilst potentially valuable, are not yet felt to have attained a degree of development comparable with the copper sulphate test.

Magnesium and Magnesium Alloy Ingots and Castings for General Engineering Purposes (B.S.2970: 1959). Price 8s. 6d.

SUPERSEDING the earlier series of standards for magnesium alloy ingots and castings—B.S.1272-1280—this publication amends the requirements of the earlier standards in the light of more recent experience in magnesium alloys. Specifications for pure magnesium ingots, and for five new alloys in various conditions, have been added.

The new specification has been modelled on B.S.1490 (Aluminium Alloy Ingots and Castings) in that general requirements are grouped in Sections One and Two for Ingots and Castings respectively, and specific requirements for each material are included in separate sections. Alloy numbers have been allocated to each material, prefixed by the letters "MAG," and symbols are used to indicate form and condition, as in B.S.1490.

Copies of the above-mentioned standards may be obtained from the British Standards Institution, 2 Park Street, London, W.1.

Atomic Progress

—continued from page 394

the restraining rim of alpha phase becomes fully plastic. No cycling damage can occur before this stage. Once this volume has transformed, temperature variations large enough to overcome the transformation hysteresis will cause plastic deformation of the alpha phase. The beta phase, which will be under hydrostatic compression, should not deform. Deformation of the alpha phase would be completely reversed on cooling and, unless voids form, no cumulative growth is likely. The last stage is when the interface reaches the surface of a fuel element. At this point, independent relaxation of the alpha and beta phases is possible, and cycling damage is to be expected.

Experimentally, the effects of thermal cycling a fuel element through the alpha-beta transformation can be simulated by electrical resistance heating with a high rate of external cooling.

The first round civil fuel elements are designed to operate with the fuel entirely within the alpha phase region. Temperature transients during operation may in some instances lead to a very small number of fuel elements operating with the fuel, at least partly in the beta phase region. From the work described it appears that, provided the number of thermal cycles of this type during a fuel element life is small, the growth will be very limited. The presence of existing voids, e.g. due to fission product gas swelling, is a complication, since thermal cycling damage can be predominantly due to swelling arising from the internal porosity. Churchman *et al*[3] note that cycling through the phase change does not give a large increase in fission product gas swelling. Clearly, with the limited information available it is difficult to predict exactly what damage will occur, particularly as it will be closely related with the detailed metallurgical structure of a given fuel element. However, all the indications are that this damage will be small and that the Magnox canning alloy will have adequate ductility to accommodate any growth which may occur.

References

1. A. B. McIntosh and T. J. Heal; Geneva Conference Paper, A/Con/15/P/49.
2. S. N. Buckley, A. G. Harding and M. B. Waldron; *J. Inst. Met.*, 1959, **87** (5), 150.
3. A. T. Churchman, R. S. Barnes and A. H. Cottrell; *J. Nuclear Energy*, 1958, **7** (1/2), 88.

Industrial News *Home and Overseas*

A Golden Jubilee

Established on June 11, 1909, under the name of Philipp Brothers, as merchants and brokers in non-ferrous metal scrap, the firm of **Philipp and Lion** celebrates its Golden Jubilee next month. The business began in one room at 118 Leadenhall Street, London. To-day, the staff of the company numbers some hundreds, and their yearly turnover runs into millions of pounds. The present activities of the firm embrace not only non-ferrous metal scrap but virgin metals, metallic ores and ferrous scrap, both internally in the U.K. and for export and import to, and from, all parts of the world.

The present senior partner, Mr. Rudolph Lion, has been with the firm from the first year of its existence, becoming a partner in October 1916, when the name of the firm was changed to its present style. In 1918, Mr. Leonard Gollance, who had joined the firm in 1912, became a partner, but his early death in 1929 brought a sad loss to the partnership.

The firm is one of the very few in the trade to-day which is entirely independent, and has maintained its individuality by remaining a partnership. It has not become a limited company, nor does it have any other firms connected with it. The business is centralized in London and has agencies and friendly connections all over the world. Philipp and Lion were one of the six firms responsible for the foundation of the National Association of Non-Ferrous Scrap Metal Merchants, and it is a happy coincidence that Mr. Jacques Lion will be President of that Association during the year in which his firm attains its Golden Jubilee.

Customers of the firm in all parts of the world, and its many friends at home, will wish the firm continued success for many years to come.

A Birmingham Meeting

Speaking at the monthly luncheon meeting of the **Non-Ferrous Club,** held on Wednesday of last week at the Queen's Hotel, Birmingham, Mr. Noel Bond-Williams, managing director of The Aston Chain and Hook Co. Ltd., told his audience of some of the factors affecting yacht racing and yacht owning so far as ocean-going yachts were concerned.

As is usual at these luncheons, a collection on behalf of some well-known charity was taken, and on this occasion 15 guineas was collected on behalf of the Royal Metal Trades Pension and Benevolent Society.

Electroplating Plant

Two fully automatic Efco-Udylite "Junior" electroplating machines have recently been built and installed by the **Electro-Chemical Engineering Co. Ltd.** at the Birmingham works of Metal Finishes Ltd. These machines are used for the bright nickel and chromium plating of electric kettle, percolator and toaster components, and their installation is enabling the company to achieve the consistent and high quality finishes that the market requires.

Over two million components annually will be processed in these plants, which are each 37½ ft. long, 8 ft. wide and 8½ ft. high. The machines are of standard design and construction, although the process tanks have been provided to meet the customer's special requirements.

A Contract from Brazil

A £300,000 contract has been placed with **Birwelco Limited,** and their subsidiary, Brown Fintube (Gt. Britain) Ltd., for the supply of six Petro-Chem-Iso-Flow furnaces and tank heaters at the Rio Duque de Cazias Refinery, Brazil, for Petroleo Brasileiro, S.A.

At Rio Duque de Caxias, four of the furnaces will be required to heat hydrocarbon vapours and hydrogen to temperatures up to 1,000°F., and will operate at pressures up to 700 lb/in². The actual duty on the furnaces varies, but the maximum is approximately 70,000,000 B.Th.U/hr., while the smallest is 10,000,000 B.Th.U/hr. The large furnaces are designed for high efficiency using a separate convection bank, the largest furnace being 20 ft. in diameter and 100 ft. high to top of stack, and one of them incorporates a separate steam superheater.

In connection with the tank heaters, a total of 180 will be installed, all of standard TF.18 type, in the various heated storage tanks on the refinery tank farm, the largest of the tanks containing up to 12 units to accommodate the heating duty.

Cemented Carbides

Development of cemented carbides as a cutting medium has, without doubt, much influenced machine shop practice over the last 30 years. A film "Cutanit Cemented Carbides," sets out to emphasize the tremendous care which goes into the production of "Cutanit," and demonstrates the exceptional qualities of this material in many varied machining applications.

Commencing with the fine tungsten oxide powder, the many manufacturing processes are followed through to the finished hard metal sintered tips. The film goes on to show the modern techniques used in the manufacture of cutting tools, and also stresses the importance of correct carbide grade selection for particular machining applications.

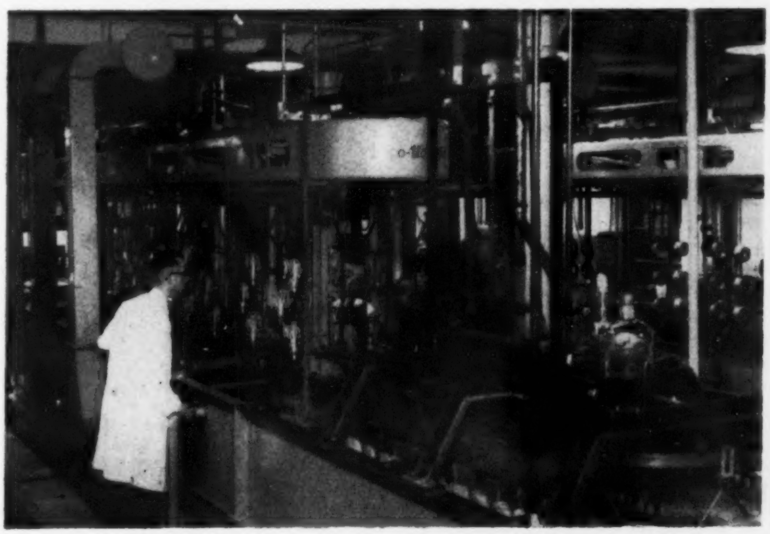
Then follows a series of sequences showing "Cutanit" in use in copy lathe turning, heavy duty milling, planing, trepanning, reaming, press tools, steel strip slitting and, finally, in a particularly abrasive application showing its outstanding performance in the manufacture of refractory bricks. "Cutanit" cemented carbides are a product of **Wm. Jessop and Sons Ltd.**

A New Film

On Thursday of last week at the British Council Theatre in London, the film "Aluminium for Sub-Zero Methane," made by **The Aluminium Development Association,** had its preview before a selected audience of the industries and authorities chiefly concerned.

The film opens with a clear indication of the significance of liquefying methane gas so as to occupy only a six-hundredth of its volume—thus becoming transportable in containers by sea, provided suitable containers could be made. The liquid is extremely cold and creates peculiar difficulties for some container materials. The film briefly refers to low temperature tests on certain aluminium alloys which were the subject of recent discussion at the Institute of Welding. Low temperature laboratory work was undertaken by several member companies of the Association and by Lloyds Register of Shipping. As a result of these exacting researches, five 400-ton capacity aluminium alloy tanks were fitted into "Methane Pioneer," which the film shows arriving off Canvey Island.

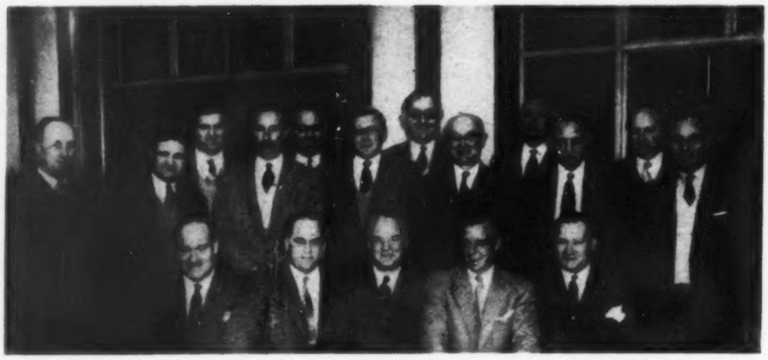
These two fully automatic Efco-Udylite "Junior" electroplating machines have been installed at the Birmingham works of Metal Finishes Ltd.



The film is largely concerned with the fabrication of two 1,000 ton aluminium alloy storage tanks on Canvey Island (one by The A.P.V. Co. Ltd. and the other by Whessoe Ltd.) and of the two 2,000 ft. aluminium alloy pipe lines running from tanks to jetty. Welding by inert-gas, metal arc was nearly all done on site, and contributes substantially to the story of what is probably the largest use of aluminium for storage vessels in this country.

An important aspect, clearly brought out by the film is the care taken by means of frequent testing and inspection to avoid risk of leakage of liquid methane, and a special feature of the whole project was 100 per cent radiographic inspection of welded joints.

This is a 16 mm. colour film, with commentary, which runs for 17½ min. It is available on loan to technical schools and colleges, works training centres, and other interested bodies having the necessary facilities. Enquiries should be addressed to the Association, 33 Grosvenor Street, London, W.1.



Members of the Metal Finishing Association at Sandwell Park Golf Club last week

Electric Melting Furnaces

Agreements have now been concluded by **G.W.B. Furnaces Ltd.** for co-operative manufacture and sale, in Great Britain and most of the Commonwealth countries, of the whole range of melting plant designed by Demag-Elektrometallurgie G.m.b.H., of Duisburg, Germany, and by the Lectromelt Furnace Division, McGraw Edison Company, of Pittsburgh, U.S.A

This agreement enables the G.W.B company to offer arc furnaces with a capacity of up to 200 tons, with or without rotating shell and alternative electrode control systems, these being static or rotating magnetic amplifier type or hydraulic.

In addition, the agreement with Demag covers submerged arc furnaces for the reduction of ores and production of ferro-alloys and calcium carbide. The field of induction melting furnaces is also well covered, enabling the British company to offer Demag designed crucible type units for mains frequency or motor alternator operations for steels, irons and non-ferrous metals. Channel type mains frequency induction furnaces may also be supplied for melting light metals, copper and copper alloys, zinc and irons.

A New Stud Welder

New stud welding equipment for use with standard arc welding transformers and mild steel studs of $\frac{3}{16}$ in. to $\frac{3}{8}$ in. dia. has been introduced by **The Stud Welding Applications Company.** This equipment has several attractive features. The controls are contained in a single unit which, when installed on the primary side of the welding transformer, can be left *in situ* and used for either arc or stud welding merely by operation of a selector switch.

The pistol-type hand tool, which is designed for use with Philips' stud welding cartridges, weighs only 2½ lb. and has an overall length of 8½ in. when welding 1 in. long studs. It is fitted with a new type of locating foot which ensures speedy and precise positioning of studs vertical to the workpiece. Simplicity of the equipment reduces servicing to a minimum.

Housed in a robust mild steel case measuring 12 in. by 12 in. by 8 in., weighing only 32 lb. and fitted with carrying handle, the control unit operates from 200-240 V or 380-440 V A.C., 50 cycle, mains supply. A safety fuse is fitted.

Golf Competition

Members of the **Metal Finishing Association** in the Birmingham area held their golf competition at Sandwell Park on Tuesday of last week. A dinner was held in the Club House following the meeting, presided over by Mr. Cyril Wharrad, chairman of the Birmingham branch of the association.

During the course of the dinner, the prizes for the competition were presented by Mr. F. W. Bulpitt. Results were as follows: Medal Round, morning competition: 1st, Mr. A. E. Abbott; 2nd, Mr. P. J. Busby; 3rd, Mr. R. G. Hughes; 4th, Mr. C. Wharrad, and 5th, Mr. A. Wharrad.

Stapleford Round, afternoon competition: 1st, Mr. A. E. Abbott; 2nd, Mr. P. J. Busby; 3rd, Mr. F. W. Bulpitt; 4th, Mr. R. G. Hughes; and 5th, Mr. F. W. Cobb.

Research Laboratories

New laboratories for the **Coil Spring Federation Research Organization** at Sheffield, which will be ready for use in July next, were described by Mr. R. Salter Bache, President of the Organization, as being among the most comprehensive of their kind in the world. Mr. Bache was speaking at the annual conference at Hythe last week.

These laboratories will enable research to be carried out on springs made from the finest wires to bars of up to 2 in. dia. In addition to work on springs and torsion bars, research will be possible on materials in wire and strip form. Metallurgical research will also be undertaken on a very wide range of ferrous and non-ferrous alloys.

A major feature of the new buildings will be a comprehensive electroplating laboratory, which has been presented to the Organization by **W. Canning and Company Ltd.** Acknowledging this generous donation, Mr. Bache said "The progressive attitude of that company towards research was demonstrated by the decision of their Board to donate the necessary plant and equipment." The new electroplating laboratory will enable further work to be done in the field of hydrogen embrittlement.

New Cold Strip Mill

As part of a planned extension of their resources for the production of medium width strip, Steel, Peech and Tozer, branch of the United Steel Companies Ltd., have placed an order with **Davy and United Engineering Company Ltd.** for a new cold strip mill for their Brinsworth plant. The mill will be equipped with electronic equipment capable of controlling the thickness of the rolled strip automatically. This system, known as automatic gauge control, produced originally under the patents of the British Iron and Steel Research Association, has been widely developed by Davy-United, and a number of important installations, both in this country and overseas, have already been carried out. The value of the Davy-United order exceeds £300,000 and the whole plant is due to go into service in the summer of 1960.

Lead and Zinc Supplies

As a result of a United Nations Conference on lead and zinc, held in the United States last week, estimated supplies of lead and zinc metal in the second half of this year will be reduced by some 45,500 and 52,000 metric tons respectively by means of voluntary curtailments in production and sales by various countries. These facts are given in a report of the Conference published in New York during the week-end.

The report said that, assuming consumption would continue at the level projected at the beginning of the meetings, the excess of available new supply of lead metal (which had been estimated at 150,000 tons for 1959) would decrease to an annual rate of 59,000 tons in the second half of 1959. For zinc metal the decrease, similarly calculated, would be from 120,000 tons to an annual rate of 16,000 tons.

The 20-nation Lead and Zinc Committee of the U.N. Economic and Social Council, which compiled the report, expressed its understanding that the undertakings to cut supply were "voluntary" and "did not entail formal commitments." At the same time, it pointed out that the effects of the reductions would "be likely to be frustrated if, while the reductions were in force, producers who have not yet announced reductions in production or exports or sales were to take advantage of the situation created in world markets by increasing their production or commercial exports or sales in 1959 substantially beyond the levels assumed in the course of the Committee's discussions, or if Governments were to make disposals from their non-commercial stocks."

In its report, the Committee urged Governments and industries "to avoid any course of action which might frustrate the efforts that are being made to bring about a satisfactory balance between supply and demand." It expressed the hope that the reduction in supplies which had been indicated would

"quickly bring about more satisfactory market conditions."

At the same time, "the great importance of increased consumption" was stressed. References were also made during the Conference to the possibility of consumers' stocks being increased in some important consuming countries.

"The Committee is of the opinion that, if the effect of these moves does not appear to be sufficient, there should be a further meeting of interested Governments," the report said, adding: "The representatives of a number of countries again expressed their concern to see the removal of the United States import quotas." Giving some details of how the estimated reduction in supplies of lead would be achieved, the report said the Soviet Union would reduce exports of lead metal this year by 10-15 per cent compared with last year, while South Africa would reduce her lead sales for the remainder of this year by 3,500 metric tons.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange warehouses rose by seven tons and were distributed as follows at the end of last week:—London 5,084 tons, Liverpool 2,348 tons, and Hull 1,090 tons.

Stocks of refined copper rose by 175 tons and were as follows:—London 2,022 tons, Liverpool 4,194 tons, Birmingham 775 tons, Manchester 3,550 tons, and Hull 375 tons.

Soviet Copper Ore

Large deposits of copper ore have been discovered in the northern Urals, beyond the Polar Circle, according to the Soviet news agency *Pravda.* This results from a recent survey by a team of geologists, who have reported their findings to a conference in Tyumen (Western Siberia).

Tin Prospects

Good American buying and heavier European sales on the London Metal Exchange have favoured the sale of tin from the Buffer Stock in recent weeks. A. Strauss and Company estimate that at least 30 per cent, and possibly 40 per cent, of the Buffer Stock has now been sold. This would represent from 7,000 to 9,000 tons out of the original stock of 23,000 tons. The American buying stems from a high level of tinplate production to meet canners' requirements in anticipation of the July strike, and is likely to be reflected later in smaller output when conditions return to normal. Without persistent buffer stock selling, prices would have been forced well above the present level, Strauss reports. The mean between the floor and the ceiling of the agreement price is £805 per ton, and this price is presumably the pivot around which it was anticipated fluctuations should occur.

The question therefore arises, Strauss continues, whether the Buffer Stock Manager would not have been justified in holding back for a rather higher price after some sales around £780, and whether it is intended to continue disposals at the current market level.

The Tin Council later this month must decide on export quotas for the third quarter—an increase would be attractive to producers, who have had a lean time, and to consumers, giving them an easier market for supplies. The third quarter, however, finds demand seasonally low, and any increase in quotas might make the market vulnerable. There is a grave danger in pursuing a policy of too hasty de-restriction, the report says, and it must be a gradual process to achieve a balanced and healthy tin industry after its recent troubles.

Annual General Meeting

On Thursday of next week, the **Institution of Mining and Metallurgy** will hold its annual general meeting in the Rooms of the Geological Society at Burlington House, Piccadilly, London, W.1. The proceedings will commence at 4 p.m. and, in addition to the conduct of ordinary business, the presentation of awards, including the Gold Medal of the Institution, will take place.

The induction of Dr. J. H. Watson, C.B.E., M.C., A.R.S.M., B.Sc., Ph.D., as President of the Institution for 1959-60 will take place during the proceedings, and will be followed by the Presidential Address, the subject of which is "Some Observations on Gold Refining and the Standards for Gold and Silver Coinage."

Men and Metals

At the annual general meeting of the Institution of Metallurgists, held in London on Tuesday last, **Professor A. J. Murphy,** M.Sc., F.I.M., F.R.Ae.S., was elected President of the Institution for the ensuing year. Professor Murphy is Principal of the College of Aero-

nautics, Cranfield, having taken up this appointment in 1955 after five years as Professor of Industrial Metallurgy at the University of Birmingham. He is also a past-president of the Institute of Metals, and is a member of the Council of the British Non-Ferrous Metals Research Association.

In succession to **Mr. R. D. Hamer,** it is announced that **Dr. Robert T. Parker** has been appointed head of Aluminium Laboratories Limited, Banbury and Geneva offices. Dr. Parker, an Associate of the Royal School of Mines, joined the Aluminium Limited Group in 1938 and transferred to Aluminium Laboratories Limited in 1946 as Head of the Metallurgical Division. In 1950 he became Director of Research at the Banbury laboratories. He had previously been engaged in research with the British Non-Ferrous Metals Research Association.

Dr. Parker is a Fellow of the Institution of Metallurgists and Fellow of the Royal Institute of Chemistry. For a number of years he has been chairman of the Aluminium and Magnesium Industry Committee of the British Non-Ferrous Metals Research Association and chairman of The Aluminium Development Association Research Committee, serving also on the Institute of Metals Publication Committee, B.N.F.M.R.A. Research Board, and a number of Government metallurgical committees. He is a past-chairman of the Oxford Local Section of the Institute of Metals.

Research and development appointments have recently been announced by the Mond Nickel Company Limited. These include the appointment of **Dr. G. L. J. Bailey,** Ph.D., B.Sc., F.I.M., as superintendent of the Development and Research Laboratory in Birmingham; **Dr. W. Betteridge,** D.Sc., Ph.D., is appointed superintendent of the Platinum Metals Research Laboratory at Acton; and **Dr. W. Steven,** B.Sc., Ph.D., F.I.M., is being transferred from Birmingham to the Development and Research Division of the International Nickel Company Inc. as director of research, and he has also been elected an assistant vice-president of that company. All these appointments take effect from June 1 next.

At the May meeting of the Institute of Physics the following were elected Fellows of the Institute:—**Mr. A. Ashmore, Mr. G. B. Banks, Mr. W. W. H. Clarke, Mr. R. P. Chasmar, Mr. W. H. Lunning, Mr. C. H. Vincent, Mr. O. M. White, Mr. R. L. Whitmore.** In addition, 39 associates, 24 graduates and 30 students were elected.

It has been announced by Simmonds Aerocessories Limited that **Mr. C. W. Clarke,** M.S.M.A., has been appointed home sales manager of the Surform division of the company. He will be responsible for the marketing in the U.K. of Surform hand-cutting tools and power tool attachments, and will operate from the sales office in London.

On Tuesday last, **Mr. Albert Bulpitt** retired after 63 years' service, 48 of them as a director, from the firm of Bulpitt and Sons Limited, aluminium ware manufacturers, of Birmingham. To mark his retirement, Mr. Bulpitt was entertained to dinner by the senior staff and presented with an engraved silver salver. His fellow directors are to present him with a portrait.

Metal Market News

VERY steady conditions prevailed on the Metal Exchange last week, and prices did not show much change over the trading period from Monday to Friday. However, sentiment was not quite so optimistic as of late and Wall Street on Thursday staged its sharpest setback for nearly six months. On the whole, however, the outlook in the United States appears to be pretty good, and if Wall Street does boil over from time to time this is not surprising. A corrective of this kind is probably all to the good. Demand for non-ferrous metals is not particularly brisk and, indeed, has not been since the Easter holidays. In regard to copper, there has been a good deal of talk about the possibility of some kind of a special "stability scheme" being introduced by a combination of producers, and it seems very likely that meetings have been held on this subject. Whether any plan acceptable to both producers and consumers can be devised is, perhaps, doubtful, but there cannot be any doubt that users of copper deplore the wide and sudden movements in the quotation on the Metal Exchange which occur from time to time. This is, of course, no new grievance against the free market, for indeed there have been grumbles almost since trading in futures began again in August 1953. The subject has, however been canvassed *ad nauseam* and this is not the place to re-open the discussion. Probably there are few people who would be prepared to say that a sterling copper price fixed and controlled by the producers is the best cure for wide fluctuations in value.

In copper, last week started off with an increase of 425 tons to 10,741 in L.M.E. stocks, and it is generally expected that the upward trend will continue. On Monday, too, it became known that the Belgian price had been reduced by ½ franc to 32·50 francs per kilo. Price movements in the standard copper quotation last week were the reverse of wide, and the tone was steady.

In all, some 9,100 tons changed hands and on balance cash, at £231, closed £2 15s. 0d. down, while three months lost £2 at £232 15s. 0d. The contango, now well established, increased from £1 at the end of the previous week to £1 15s. 0d. last Friday, and may well get wider yet. Kerb business was probably not very brisk last week, but there is always a certain amount of dealing carried on outside the official trading time, and sometimes, of course, activity on the Kerb is very marked. This is especially the case in the afternoon, when sometimes news from America causes something of a flutter. On Friday last, for example, the price on the Kerb was reported £1 up at one time, but at the close this had been reduced to about 10s.

Stocks of tin fell by 218 tons to 8,515 tons, and there are good grounds for believing that this erosion will continue. Movements in price were small, and the turnover fell short of 1,000 tons. On balance, both positions lost 10s. to close at £783 10s. 0d. cash and £784 three months. As far as is known, the Pool is continuing to reduce its holding by means of sales in the ring. Tin is very steady but a somewhat uninteresting market. During the second half of the week, the American price of lead was increased by ½ cent to 12 cents, but the London market did not seem to be much impressed, although values improved. After a turnover of 9,300 tons, May closed 25s. up at £70 15s. 0d., while August put on 22s. 6d. at £71 17s. 6d. In zinc, the tonnage changing hands was 10,550 tons, May being £2 5s. 0d. up at £76 15s. 0d., while August was only 25s. higher at £75 5s. 0d.

Birmingham

The employment position in the Midlands continues to improve. Firms which had a spell of short-time working have returned to a full working week, and more activity is reflected in a larger number of vacancies. That this is not having an immediate effect on consumption of non-ferrous metals is explained by the existence of stocks. New records for production and sales of cars have been made by the manufacturers within the last month. Makers of heavy electrical equipment are busy on power station contracts in this country and abroad. Makers of hand tools need more orders, but competition is very keen in this trade.

Amongst the signs of improvement in iron and steel trading are more orders for re-rolled steel, and bigger business in cold rolled sheets. The mills are working more shifts and enquiries are more numerous than they have been for some time. A great deal of rebuilding is taking place in the Midland area, but orders for structural steel are not keeping pace with the completion of old contracts. Foundries working for the motor trade are fully employed, and this business is likely to continue for a long time ahead. Producers of heavy castings are well employed, and there is expansion in the market for drop forgings.

New York

Copper futures were firm, lead steady and zinc very steady over the week-end. Leading lead-zinc sources said the U.N. Conference action was constructive, with American Metal Climax Company following up recommendations of the U.N. Committee with a cut in lead and zinc output. Effective immediately, they will drop 6,500 short tons of lead and 2,000 tons of zinc from their American properties, and, effective July 1, cut 4,000 tons of slab zinc from their Blakewell smelter. Lead and zinc sources paid little attention to the latest Appropriation Committee move in the stockpile. Lead and zinc sales were quiet. Custom smelters reported a fair business, with no change in the producer status. Tin was quiet.

The House Appropriations Committee has ordered the Administration to stop replacing stockpile materials it must rotate to prevent deterioration. This would affect such perishables as rubber, fibres and oils. The General Services Administration had told the Committee it would have to sell some 43 million dollars' worth of these commodities during the fiscal year starting July 1, and that they would cost 49,400,000 dollars to replace. The Appropriations Committee said it would expect the G.S.A. to sell off these deteriorating commodities, but refused to allow the funds requested to repurchase the rotated materials.

The Committee took another action aimed at eventual reduction in the stockpile programme. It cancelled out spending authority that would otherwise be outstanding for the stockpile programme as of June 30, 1960. It said the purpose of this was to force the G.S.A. to come to Congress for new funds in the following year, ensuring annual Congressional review of the programme. As of July 1, 1959, the Committee said, the stockpile programme would have available for spending 96,500,000 dollars from previous unspent appropriations, and it will receive during the year another 43,300,000 dollars from the sale of materials under the rotation programme. The Committee said G.S.A. could spend 33 million dollars of this total for storage inventory and other operating costs during the coming year. The remaining 107 million dollars would be cancelled out, so that the programme would start the following year with no output balances on hand.

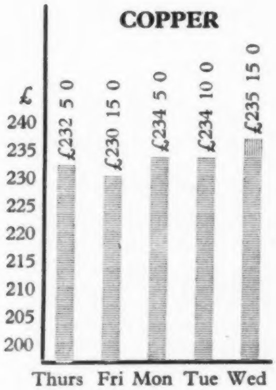
The total inventory of raw materials in various Government stockpiles on December 31, 1958, was 8,000 million dollars, the Committee said. Of this total, 4,200 million dollars was in excess of the stockpile objectives. The 33 million dollars authorized by the Committee includes the Budget request of 6,500,000 dollars for acquisition of new materials.

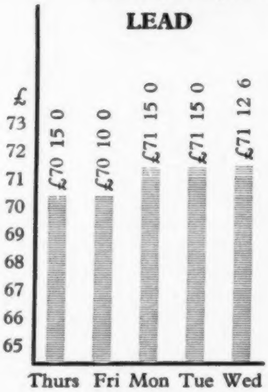
Due to over-production, it is understood that the American Zinc, Lead and Smelting Company is proposing to reduce output of slab zinc by five per cent, as from July 1 next. This reduction will amount to between six and seven thousand tons per annum.

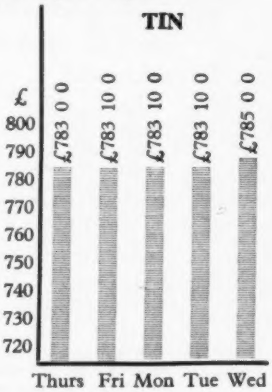
Non-Ferrous Metal Prices

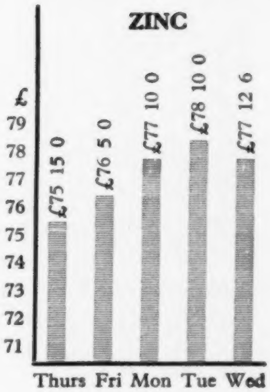
London Metal Exchange

Thursday 7 May to Wednesday 13 May 1959









Primary Metals

All prices quoted are those available at 2 p.m. 13/5/59

		£	s.	d.
Aluminium Ingots....	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%..	„	190	0	0
Antimony Oxide......	„	180	0	0
Antimony Sulphide Lump..............	„	190	0	0
Antimony Sulphide Black Powder........	„	205	0	0
Arsenic..............	„	400	0	0
Bismuth 99·95%......	lb.		16	0
Cadmium 99·9%	„		9	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		14	0
Columbite.... per unit			—	
Copper H.C. Electro..	ton	235	15	0
Fire Refined 99·70%	„	234	0	0
Fire Refined 99·50%	„	233	0	0

		£	s.	d.
Copper Sulphate	ton	76	0	0
Germanium	grm.		—	
Gold	oz.	12	9	3¾
Indium	„		10	0
Iridium.............	„	24	0	0
Lanthanum	grm.		15	0
Lead English..........	ton	71	12	6
Magnesium Ingots....	lb.		2	3
Notched Bar	„		2	9½
Powder Grade 4......	„		6	1
Alloy Ingot, A8 or AZ91	„		2	4
Manganese Metal....	ton	245	0	0
Mercury	flask	78	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5.	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	

		£	s.	d.
Palladium	oz.	7	5	0
Platinum	„	28	10	0
Rhodium	„	41	0	0
Ruthenium	„	18	0	0
Selenium	lb.		nom.	
Silicon 98%..........	ton		nom.	
Silver Spot Bars......	oz.		6	7⅛
Tellurium	lb.		15	0
Tin..................	ton	785	0	0
***Zinc**				
Electrolytic..........	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	76	12	6
Dust 95/97%........	„	109	0	0
Dust 98/99%........	„	115	0	0
Granulated 99+% ..	„	101	12	6
Granulated 99·99+%	„	115	11	3

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏£/ton		Canada c/lb ≏£/ton		France fr/kg ≏£/ton		Italy lire/kg ≏£/ton		Switzerland fr/kg ≏£/ton		United States c/lb ≏£/ton	
Aluminium			22.50	185 17 6	224	163 0	375	221 5	2.50	212 10	26.80	214 10
Antimony 99.0					220	165 0	445	262 10			29.00	232 0
Cadmium					1,350	1,012 10					130.00	1,040 0
Copper												
Crude												
Wire bars 99.9							460	271 10 0				
Electrolytic	32.50	239 5 0	30.50	252 0	327	245 5			2.90	246 12 6	31.50	252 0
Lead			10.25	84 12 6	106	79 12 6	167	98 17 6	.85	74 0	12.00	96 0
Magnesium												
Nickel			70.00	578 5	900	675 0	1,200	708 0	7.50]	637 10	74.00	592 0
Tin	111.25	817 2 6			1,124	843 0	1,500	885 0	9.60	816 0	102.62	820 17 6
Zinc												
Prime western			10.75	88 15 0							11.00	88 0
High grade 99.95			11.35	93 15 0								
High grade 99.99			11.75	97 0 0								
Thermic					114.00	85 12 6						
Electrolytic					122.00	91 12 6	170	100 7 6	.95	80 17 6	12.25	98 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 13/5/59

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0
†Aluminium Alloys (Secondary)				
B.S. 1490 L.M.1	ton	—		
B.S. 1490 L.M.2	„	—		
B.S. 1490 L.M.4	„	—		
B.S. 1490 L.M.6	„	—		
***Aluminium Bronze**				
BSS 1400 AB.1	ton	234	0	0
BSS 1400 AB.2	„	240	0	0

*Brass		£	s.	d.
BSS 1400-B3 65/35	ton	156	0	0
BSS 249	„	—		
BSS 1400-B6 85/15	„	205	0	0
***Gunmetal**				
R.C.H. 3/4% ton	„	—		
(85/5/5/5)	„	194	0	0
(86/7/5/2)	„	204	0	0
(88/10/2/1)	„	245	0	0
(88/10/2/½)	„	256	0	0
***Manganese Bronze**				
BSS 1400 HTB1	„	185	0	0
BSS 1400 HTB2	„	—		
BSS 1400 HTB3	„	208	0	0
Nickel Silver				
Casting Quality 12%	„	220	0	0
„ „ 16%	„	230	0	0
„ „ 18%	„	240	0	0
***Phosphor Bronze**				
B.S. 1400 P.B.1.(A.I.D. released)	„	288	0	0
B.S. 1400 L.P.B.1	„	211	0	0

**Average prices for the last week-end.*

Phosphor Copper		£	s.	d.
10%	ton	253	0	0
15%	„	255	10	0
Phosphor Tin				
5%	„	—		
Silicon Bronze				
BSS 1400-SB1	„	247	0	0
Solder, soft, BSS 219				
Grade C Tinmans	„	366	5	0
Grade D Plumbers	„	295	5	0
Grade M	„	400	15	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.	—		
Type 9 „	„	—		
Zinc Alloys				
Mazak III	ton	108	16	3
Mazak V	„	112	16	3
Kayem	„	118	16	3
Kayem II	„	124	16	3
Sodium-Zinc	lb.		2	6[illegible]

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium				
Sheet 10 S.W.G.	lb.		2	8[illegible]
Sheet 18 S.W.G.	„		2	10[illegible]
Sheet 24 S.W.G.	„		3	1[illegible]
Strip 10 S.W.G.	„		2	8[illegible]
Strip 18 S.W.G.	„		2	9[illegible]
Strip 24 S.W.G.	„		2	11
Circles 22 S.W.G.	„		3	2[illegible]
Circles 18 S.W.G.	„		3	1[illegible]
Circles 12 S.W.G.	„		3	0[illegible]
Plate as rolled	„		2	8
Sections	„		3	2
Wire 10 S.W.G.	„		2	11[illegible]
Tubes 1 in. o.d. 16 S.W.G.	„		4	1
Aluminium Alloys				
BS1470. HS10W.				
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3[illegible]
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2[illegible]
Strip 24 S.W.G.	„		3	10[illegible]
BS1477. HP30M.				
Plate as rolled	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	9[illegible]
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0[illegible]
Strip 10 S.W.G.	„		3	10[illegible]
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9[illegible]
BS1477. HPC15WP.				
Plate heat treated	„		3	6[illegible]
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10[illegible]
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0[illegible]
BS1476. HE10WP.				
Sections	„		3	1[illegible]
Brass				
Tubes	„		1	10[illegible]
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	252	5	0
Extruded Bar	lb.		2	0[illegible]
Extruded Bar (Pure Metal Basis)	„		—	

Brass				
Condenser Plate (Yellow Metal)	ton	187	0	0
Condenser Plate (Naval Brass)	„	199	0	0
Wire	lb.		2	7[illegible]
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Copper				
Tubes	lb.		2	3[illegible]
Sheet	ton	262	0	0
Strip	„	262	0	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	281	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	6[illegible]

Lead				
Pipes (London)	ton	111	5	0
Sheet (London)	„	109	0	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	lb.		3	8
Wire 10%	„		4	2[illegible]
Phosphor Bronze				
Wire	„		4	1

Titanium (1,000 lb. lots)			
Billet over 4″ dia.-18″ dia.	lb.	63/-	64/-
Rod 4″ dia.-·250″ dia.	„	75/-	112/-
Wire under ·250″ dia.-·036″ dia.	„	146/-	222/-
Sheet 8′ × 2′ × ·250″-·010″		88/-	157/-
Strip ·048″-·003″	„	100/-	350/-
Tube	„		300/-
Extrusions	„		120/-

Zinc				
Sheet	ton	113	10	0
Strip	„	nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 12/5/59.

Aluminium	£
New Cuttings	146
Old Rolled	126
Segregated Turnings	98
Brass	
Cuttings	155
Rod Ends	143
Heavy Yellow	126
Light	121
Rolled	146
Collected Scrap	123
Turnings	137
Copper	
Wire	214
Firebox, cut up	213
Heavy	208
Light	203
Cuttings	214
Turnings	194
Braziery	163

Gunmetal	£
Gear Wheels	183
Admiralty	183
Commercial	165
Turnings	158
Lead	
Scrap	62
Nickel	
Cuttings	—
Anodes	550
Phosphor Bronze	
Scrap	165
Turnings	158
Zinc	
Remelted	67
Cuttings	54
Old Zinc	38

Financial News

Gibbons (Dudley) Ltd.

Profit 1958, £303,637 (£349,225), less tax £150,475 (£179,129), leaving £153,162 (£170,096). Credit minority interest £110 (£452 debit). To general reserve £80,000 (£95,000), employees' benefit fund £9,000 (same), capital reserve £20,000 (£30,000). Final dividend 12 per cent (10½ per cent), making 16½ per cent (15 per cent) £39,873 (£34,607),, forward £69,360 (£67,061).

London Electric Wire

Group profit, after tax, 1958, £452,666 (£437,946) and dividend 15 (12½) per cent. Fixed assets £2,640,731 (£2,524,780), associated company £452,390 (£458,705). Net current assets £6,145,465 (£5,823,986), including quoted investments (£748,370 (£1,001,205), market value £984,889 (£1,027,548). Commitments £134,000.

Newman Industries

Group net profit, 1958, £43,876 (£37,420), and dividend 10 per cent (same). Net current assets £782,217 (£825,743), including debt to bank £195,828 (£52,255). Net assets £1,296,585 (£1,265,442).

Pyrene Company Ltd.

Group net profit for 1958 £368,409 (£216,285) and dividend 27½ per cent (25 per cent). Net current assets £1,994,697 (£1,723,322). Cash is £272,110 (£137,328) and bank loan £12,876 £382,285). Reserves are £1,395,552 (£1,155,720) and commitments £58,800.

Phosphor Bronze Co.

Established some 80 years, this company is, within the next few months, likely to be closed down, according to a statement made by the chairman of Birfield Limited at the annual meeting of that company last week. It is understood that four other companies in the Birfield group will take over the work of the Phosphor Bronze Company, and the workpeople affected by this decision are to be asked whether they wish to move to other firms within the group.

A.P.V. Company

Group profit, 1958, £368,599 (£222,255) and dividend 5 per cent (nil). Current assets £4,102,157 (£4,085,150), liabilities £1,335,749 (£1,529,281).

Gaskell and Chambers

Group net profit, 1958, £124,791 (£86,873), dividend 35 per cent (same) and capital payment 5 per cent (paid in January). Fixed assets £599,841 (£565,871), net current assets £726,865 (£675,857), including investments £32,923 (£32,993), market value £25,441 (£24,857).

Manganese Bronze and Brass

Group accounts for the year to end of December, 1958, show a profit before tax of £683,722, against £616,347 for the previous year. This is after charging for depreciation at £11,688. The directors recommend a final dividend of 8d. per share, making 1s. 0½d. for the year, compared with 9¾d. for the previous year.

Norwegian Aluminium

A/S Aardal and Sunndal Verk, biggest Norwegian aluminium producers, broke all previous records with an output of 71,540 tons of aluminium metal in 1958, says the firm's annual report. Surveying market conditions, the report states that 1958 was marked by an abundant supply of aluminium, with fierce competition between producers. Like other aluminium producers, Aardal and Sunndal had been obliged to cut its prices in 1958, but had managed to sell all of its increased output.

Annual output capacity at the firm's aluminium smelter in Aardal, west Norway, is being gradually increased from nearly 30,000 tons at present to 64,000 tons by the end of 1961. Plans are being made to expand capacity further—by an additional 32,000 tons—by 1963-65. The Sunndal plant is also being expanded, and capacity will rise this year by 10,000 tons, to 50,000 tons annually, while the next expansion stage will increase yearly capacity by a further 25,000 to 30,000 tons, bringing it to 75,000-80,000 tons.

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

West Germany (D-marks per 100 kilos):		
Used copper wire ..	(£205.17.6)	235
Heavy copper	(£201.10.0)	230
Light copper	(£175.5.0)	200
Heavy brass	(£118.5.0)	135
Light brass	(£92.0.0)	105
Soft lead scrap	(£57.0.0)	65
Zinc scrap	(£36.15.0)	42
Used aluminium unsorted	(£83.5.0)	95
France (francs per kilo):		
Electrolytic copper scrap	(£191.5.0)	255
Heavy copper	(£191.5.0)	255
No. 1 copper wire ..	(£180.0.0)	240
Light brass	(£112.12.6)	150
Zinc castings	(£48.15.0)	65
Lead	(£64.12.6)	86
Aluminium	(£120.0.0)	160

Italy (lire per kilo):		
Aluminium soft sheet clippings (new) ..	(£197.12.6)	335
Aluminium copper alloy	(£126.17.6)	215
Lead, soft, first quality	(£75.12.6)	128
Lead, battery plates	(£41.17.6)	71
Copper, first grade	(£215.10.0)	365
Copper, second grade	(£203.2.6)	345
Bronze, first quality machinery	(£200.15.0)	340
Bronze, commercial gunmetal	(£171.2.6)	290
Brass, heavy........	(£138.15.0)	235
Brass, light	(£123.17.6)	210
Brass, bar turnings ..	(£127.0.0)	215
New zinc sheet clippings	(£51.5.0)	97
Old zinc	(£42.10.0)	72

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Scientific Refiners (Sales) Limited (625136), 52 Alicia Gardens, Kenton, Middlesex. Registered April 6, 1959. To carry on business of dealers in, buyers, sellers, merchants and manufacturers of non-ferrous metals, scrap metals, iron and steel, etc. Nominal capital, £100 in 95 "A" shares of £1 and 100 "B" shares of 1s. each. Director: Robert Cole.

Hayward and Cook Limited (625242), 221 Chester Street, Birmingham, 6. Registered April 7, 1959. To take over business of scrap iron, steel and metal merchants carried on as "Hayward and Cook" at Birmingham, etc. Nominal capital, £10,000 in £1 shares. Directors: Harold Cook, John Cook, Mrs. Lois J. Cook and Mrs. Winifred P. Cook.

Wm. C. Long and Son Limited (625254), 1 Lewin's Road, Epsom, Surrey. Registered April 7, 1959. To carry on business of bronze, brass and iron founders, etc. Nominal capital, £3,000 in £1 shares. Directors: Wm. C. Long, Malcolm W. Long, Mrs. Bertha H. Long and Mrs. Alfreda N. Long.

T. Midgley and Sons Limited (625485), Reservoir Road, Hull. Registered April 9, 1959. To carry on business of scrap metal merchants, etc. Nominal capital, £1,000 in £1 shares. Directors: Tom Midgley and Mrs. A. Midgley.

Park Metal Refinery (Bradford) Limited (625533), 61 North Parade, Bradford. Registered April 9, 1959. Nominal capital, £500 in £1 shares. Directors: Alan J. Hird and David A. Hird.

Lincroweld Ltd. (625730), 2 Bentinck Street, W.1. Registered April 13, 1959. To carry on the business of stockists, distributors and manufacturers of and dealers in electric arc and other welding and cutting equipment, etc. Nominal capital, £5,000 in £1 shares. Directors: Horace Linklater, Horace Crow and Geoffrey J. Tubb.

Basildon Die-Casting Company Limited (625862), 21 Bowlers Croft, Honywood Road, Basildon, Essex. Registered April 14, 1959. Nominal capital, £2,000 in £1 shares. Directors: James H. W. Baker and Angela Davies.

Metal Economics (Seaguard) Limited (626232), 11a The Strand, Exmouth, Devon. Registered April 20, 1959. To carry on the business of corrosion engineers, etc. Nominal capital, £1,000 in £1 shares. Directors: James W. Bicker-Caarten, Geoffrey B. Bonds, Francis D. Murphy and Sacheverell R. Sitwell.

Diagrit Electrometallics Ltd. (626600), Pattenden Lane, Marden, Kent. Registered April 24, 1959. To carry on business of electro, nickel and chromium platers, etc. Nominal capital, £6,000 in £1 shares. Directors: John C. F. Dawkins and Joyce G. Dawkins.

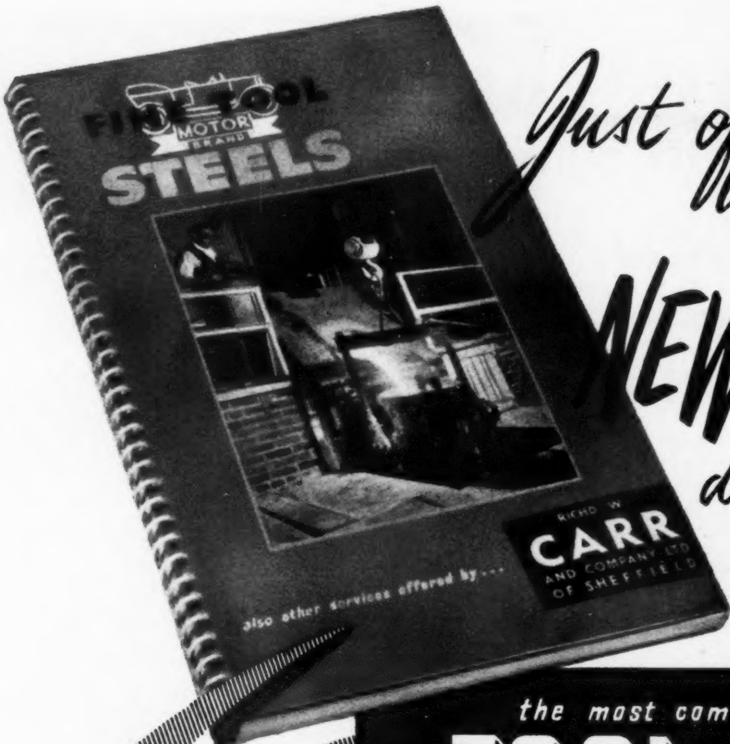
Metal Fabrications (Southampton) Ltd. (626620), Peel Street, Southampton. Registered April 25, 1959. Nominal capital, £1,000 in £1 shares. Directors: Robert P. Reeves and Ann Reeves, 19 Bullar Road, Southampton.

THE STOCK EXCHANGE

Prices Generally Well Maintained And Some Strong Features In Evidence

ISSUED CAPITAL ●	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 12 MAY +RISE—FALL		DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1959 HIGH	1959 LOW	1958 HIGH	1958 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	26/9	+3d.	9	10	6 14 6	27/-	23/3	24/9	17/6
400,000	2/-	Anti-Attrition Metal	1/3	—3d.	4	8½	6 8 0	1/6	1/3	1/9	1/3
41,305,038	Stk. (£1)	Associated Electrical Industries ...	60/6		15	15	4 19 3	61/9	54/-	58/9	46/6
1,609,032	1	Birfield	48/9	+1/9	15	15	6 3 0	59/-	47/-	62/4½	46/3
3,196,667	1	Birmid Industries	75/9	+3d.	17½	17½	4 12 3	76/10½	72/-	77/6	55/3
5,630,344	Stk. (£1)	Birmingham Small Arms	43/6	+3d.	11	10	5 1 3	43/6	36/1½	39/-	23/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	16/3		5	5	6 3 0	16/3	15/-	16/1½	14/7½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	17/9		6	6	6 15 3	18/1½	17/9	17/4½	16/6
500,000	1	Bolton (Thos.) & Sons	30/-		10	10	6 13 3	30/-	27/6	28/9	24/-
300,000	1	Ditto Pref. 5%	15/6		5	5	6 9 0	15/6	15/-	16/-	15/-
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/-		7	7	7 0 0	—	—	20/4½	19/-
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	19/6		6	6	6 3 0	19/7½	18/9	20/-	18/4½
15,000,000	Stk. (£1)	British Insulated Callender's Cables	55/6	—6d.	12½	12½	4 10 0	56/-	47/6	52/6	38/9
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	58/-	—6d.	10	10	3 9 0	58/6	49/3	52/-	28/3
600,000	Stk. (5/-)	Canning (W.) & Co.	32/-	+9d.	25 + *2½C	25	3 18 0	32/-	24/9	25/3	19/3
60,484	1/-	Carr (Chas.)	2/1½	+3d.	12½	25	5 17 9	2/3	1/3	2/3	1/4½
150,000	2/-	Case (Alfred) & Co. Ltd.	5/3	+1½d.	25	25	9 10 6	5/3	4/7½	5/3	4/-
555,000	1	Clifford (Chas.) Ltd.	23/6		10	10	8 10 3	23/6	22/6	22/-	16/-
45,000	1	Ditto Cum. Pref. 6%	16/-		6	6	7 10 0	16/-	15/3	16/-	15/-
250,000	2/-	Coley Metals	4/-		20	25	10 0 0	4/-	2/10½	4/6	2/6
8,730,596	1	Cons. Zinc Corp.†	62/-	—3d.	18¾	22½	6 1 0	67/6	60/-	65/3	41/-
1,509,528	1	Davy & United	103/9	—2/6	20	15	3 17 0	106/3	86/-	87/-	45/9
5,830,000	5/-	Delta Metal	16/4½xcap	—4½d.	31‡	30	4 14 9	33/7½	16/4½	25/-	17/7½
4,600,000	Stk. (£1)	Enfield Rolling Mills Ltd.	49/-	—1/3	15	12½	6 2 6	50/3	36/7½	38/-	22/9
750,000	1	Evered & Co.	31/6		10 §	15 Z	6 7 0	31/6	30/-	30/-	26/
18,000,000	Stk. (£1)	General Electric Co.	32/6	—3d.	10P	12½		40/3	30/9	40/6	29/6
1,500,000	Stk. (10/-)	General Refractories Ltd.	34/-	+1/6	20	20	5 17 9	40/-	32/6	39/3	27/3
401,240	1	Gibbons (Dudley) Ltd.	65/-	+1/-	16½	15	5 1 6	66/6	64/-	67/6	61/-
750,000	5/-	Glacier Metal Co. Ltd.	7/3		11½	11½	7 18 6	7/3	6/7½	8/3	5/-
1,750,000	5/-	Glynwed Tubes	19/-		20	20	5 5 3	19/3	16/4½	18/1½	12/10½
5,421,049	10/-	Goodlass Wall & Lead Industries ...	35/6	+3d.	13‖	18Z	3 13 0	35/6	28/7½	30/9	17/3
342,195	1	Greenwood & Batley	84/-	+1/-	20	17½	4 15 3	84/-	75/-	57/9	45/-
396,000	5/-	Harrison (B'ham) Ord.	19/-	+6d.	*17½	*15	4 12 0	19/-	14/11½	15/9	11/6
150,000	1	Ditto Cum. Pref. 7%	19/6		7	7	7 3 6	—	—	19/9	18/4½
1,075,167	5/-	Heenan Group	8/1½	—1½d.	10	10‡	6 3 0	8/6	7/6	9/7½	6/9
236,958,260	Stk. (£1)	Imperial Chemical Industries ...	34/6		12Z	10	4 12 9	38/3	33/9	38/-	24/3
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	17/-		5	5	5 17 9	17/1½	16/-	17/1½	16/-
14,584,025	**	International Nickel	164	—⅞	$2.60	$3.75	2 16 9	171	153	169	132⅞
860,000	5/-	Jenks (E. P.), Ltd.	10/6	+6d.	14	27½ϕ	6 13 3	10/6	8/9	10/-	6/7½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/3	15/4½	16/9	15/-
3,987,435	1	Ditto Ord.	55/6	+5/6	10	10	3 12 0	55/6	44/3	47/-	36/6
600,000	10/-	Keith, Blackman	28/9		17½E	15	6 1 9	28/9	25/-	28/9	15/-
320,000	4/-	London Aluminium	5/9	+1½d.	10	10	6 19 3	6/4½	5/3	6/-	3/-
765,012	1	McKechnie Brothers Ord.	42/6		15	15	7 1 3	45/-	42/6	45/-	32/-
1,530,024	1	Ditto A Ord.	39/6		15	15	7 12 0	43/6	39/6	45/-	30/-
1,108,268	5/-	Manganese Bronze & Brass	16/3		20⅝	20	6 8 3	16/3	13/9	14/1½	8/9
50,628	6/-	Ditto (7½% N.C. Pref.)	6/-		7½	7½	7 10 0	—	—	6/3	5/6
13,098,855	Stk (£1)	Metal Box	78/-	+3d.	11	11	2 16 6	78/9	66/6	73/3	40/6
415,760	Stk. (2/-)	Metal Traders	9/9		50	50	10 5 3	9/9	8/4½	9/-	6/3
160,000	1	Mint (The) Birmingham	25/-		10	10	8 0 0	25/-	22/-	22/9	19/-
80,000	5	Ditto Pref. 6%	72/6		6	6	8 5 6	75/6	69/-	83/6	69/-
3,705,670	Stk. (£1)	Morgan Crucible A	46/6		10	10	4 6 0	46/6	43/6	45/-	34/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/6		5½	5½	6 5 9	18/6	17/6	18/-	17/-
2,200,000	Stk. (£1)	Murex	46/-	—9d.	17½	20	7 12 3	50/-	42/-	58/9	46/-
468,000	5/-	Ratcliffs (Great Bridge)	9/9xcap		10R	10	3 17 0	11/6	9/9	11/1½	6/10½
234,960	10/-	Sanderson Bros. & Newbould ...	31/6		20	27½D	6 7 0	31/6	27/9	27/3	24/6
1,365,000	Stk. (5/-)	Serck	20/10½	—4½d.	15	17½	3 12 0	20/10½	18/-	18/7½	11/-
6,698,586	Stk. (£1)	Stone-Platt Industries	51/9		15	12½	5 16 0	51/9	43/3	45/6	22/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	17/6		5½	5½	6 5 9	17/6	15/10½	16/3	12/7½
18,255,218	Stk. (£1)	Tube Investments Ord.	85/6	+6d.	17½	15	4 1 6	86/6	72/-	86/-	48/4½
41,000,000	Stk. (£1)	Vickers	33/9		10	10	5 18 6	37/-	30/6	36/3	28/9
750,000	Stk. (£1)	Ditto Pref. 5%	14/3	—3d.	5	5	7 0 3	15/0¾	14/3	15/9	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	21/6	+6d.	*5	*5	7 3 9A	22/7½	21/-	23/-	21/3
2,200,000	1	Ward (Thos. W.), Ord.	89/6	+3d.	20	15	4 9 3	89/6	83/6	87/3	70/9
2,666,034	Stk. (£1)	Westinghouse Brake	43/6	—6d.	10	10	4 12 0	47/-	39/9	46/6	32/6
225,000	2/-	Wolverhampton Die-Casting ...	9/10½	—4½d.	30	25	6 1 6	10/6	8/8½	10/1½	7/-
591,000	5/-	Wolverhampton Metal	26/3		27½	27½	5 4 9	28/6	21/6	22/9	14/9
78,465	2/6	Wright, Bindley & Gell	6/6	+7½d.	20	20	7 13 9	6/7½	4/11½	5/4½	2/9
124,140	1	Ditto Cum. Pref. 6%	13/9		6	6	8 14 6	13/9	13/6	13/-	11/3
150,000	1/-	Zinc Alloy Rust Proof	3/-		27	40D	9 0 0	3/1½	2/9	3/1½	2/7½

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting **Shares of no Par Value. ‡ and 100% Capitalized Issue. ●The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. P Interim dividend since reduced. § And Special distribution of 2½% free of tax. R And 33⅓% capitalized issue in 8% Maximum Ordinary 5/- Stock Units.



Just off the Press!

A NEW BOOKLET

detailing

the most comprehensive stock of

TOOL STEEL

in the country

Copies mailed free on request. Ask for yours

NOW

CAT. 459

★ We make a Brand of Steel for every Tool Steel application.

★ Large Stocks of Alloy Steels for maintenance uses.

★ We can Heat Treat your Finished Tools and Components at our Birmingham and London Heat Treatment Departments.

★ Engineers' Small Tools supplied from extensive stocks.

RICHD. W. CARR & COMPANY LTD.

Head Office and Works: Pluto Works, Wadsley Bridge, SHEFFIELD, 6.
Telephone: Sheffield 348721 (5 lines). Telegrams: Pluton, Sheffield, 6.

South Midlands Branch: Warehouse and Heat Treatment Dept., Keeley St., Bordesley, BIRMINGHAM, 9.
Telephone: Victoria 1144. Telegrams: Pluton Birmingham 9.

London Branch: Warehouse and Heat Treatment Dept., Third Cross Road, TWICKENHAM, Middx.
Telephone: Popesgrove 0151. Telegrams: Carrlond, Twickenham, Middx.

EYRE
Aluminium Alloy Ingots

ESCO Gunmetal and Phosphor Bronze Ingots

THE
EYRE SMELTING CO. LTD.

TANDEM WHITE METALS · TANDEM BEARINGS
ARIEL & ESCO CHILLCAST PHOSPHOR BRONZE RODS

MAGNESIUM

you get more than a metal from

MEL

As sole producers of pure magnesium
in Great Britain, and as the recognised authorities
on every aspect of magnesium technology

we *offer* a complete service from
design to production

we *sell* magnesium and its alloys

we *buy* magnesium scrap

Magnesium Elektron Limited

Clifton Junction Manchester Swinton 2511
London Office: 5 Charles II Street SW1 Trafalgar 1646
Magnesium Elektron, Inc., New York 20, USA

PHOSPHOR COPPER

AND ALL MASTER ALLOYS

MANUFACTURERS OF

NON-FERROUS METAL INGOTS

to all

REQUIRED SPECIFICATIONS

Prompt Deliveries

RHONDDA METAL Co, LTD.

PORTH GLAM.

TELEPHONE: PORTH 280

LONDON OFFICE

1, HAY HILL, LONDON, W.1

TELEPHONE: MAYFAIR 4454

Rate: Advertisements set in run-on style 4d. per word, minimum 4/–. Semi-displayed announcements are charged at 22/6 per inch depth. Box Numbers: add 5 words, plus 1/– for registration and forwarding replies. "Copy" accepted at London Office up to 1st post on each Friday for the following Friday's issue.

METAL INDUSTRY
CLASSIFIED ADVERTISEMENTS

Trade Discounts: Details upon application to "Metal Industry," Dorset House, Stamford Street, London, S.E.1. Remittances payable to Iliffe & Sons Ltd. The proprietors retain the right to refuse or withdraw "copy" at their discretion and accept no responsibility for matters arising from clerical or printers' errors.

APPOINTMENTS VACANT

FOREMAN required for a small Electroplating and Phosphating Plant. Experience in assessing piecework desirable. Good canteen facilities and pension scheme. Applications in writing, stating age, experience and salary expected, to Employment Manager, Johnson & Phillips Ltd., Charlton, S.E.7. [7785

ASSISTANT required in laboratory engaged in electroplating and other metal finishing investigations. The position would suit a young chemist with relevant experience or a plater with knowledge of solution control. Excellent working conditions. Superannuation scheme. Send full details, including age, qualifications and present salary, in confidence, to the Secretary, PERA, Melton Mowbray, Leics. [7784

PATENT Examiners and Patent Officers. Pensionable posts for men or women for scientific, technical and legal work on Patent applications. Age at least 21 and under 28, with extension for regular Forces Service and Overseas Civil Service. Qualifications: normally first or second class honours degree in physics, chemistry, engineering, or mathematics, or equivalent attainment, or professional qualification, e.g. A.M.I.C.E., A.M.I.Mech.E., A.M.I.E.E., A.R.I.C. London salary (men) £655-£1,460; provision for starting pay above minimum. Promotion prospects. Write Civil Service Commission, 17 North Audley Street, London, W.1, for application form, quoting S128/59. [7782

CAPACITY AVAILABLE

PRODUCTION FACILITIES AVAILABLE.

ESTABLISHED manufacturers, S.E. London, specializing in high precision mass-produced light metal stampings, formings, assemblies, able to undertake other contracts owing to adverse American Customs ruling on own products. Modern plant, presses up to 60 tons, stove enamelling, Rotofinish precision tumbling, barrel plating, zinc die-casting, plastics moulding. Own design office and toolroom habitually tackle difficult multiple progression tool problems. Write Box 3568, c/o Metal Industry. [7781

SHEET Metal Work, Metal Spinning, Deep Drawn Pressings, Stamping Press capacity 200 tons. Max. draw 15". Enquiries or specifications to Wades (Halifax) Ltd., Arden Works, Fenton Road, Halifax. [0019

KELLERING and Cam Profiling Capacity up to 8 ft. × 6 ft., or 6 ft. diameter. ARMYTAGE BROS. (KNOTTINGLEY) Ltd., The Foundry, Knottingley, Yorkshire. Tel. Knottingley 2743/4. [0001

HEAT TREATMENTS

HEAT Treatment. A.I.D. Approved, all wrought and cast Light Alloys. Large sizes a speciality. Electro Heat Treatments Ltd., Bull Lane, West Bromwich. Phone Wes 0756. [0005

MACHINERY FOR SALE

E.M.B. No. 12 Diecasting Machine, good working order, replaced by modern machine; seen West of England. Price £300. Box 3443, c/o Metal Industry. [7776

MATERIALS FOR SALE

FOR Sale, New Copper Plate Anodes, 22" × 13" × ½". Write Box 3600, c/o Metal Industry. [7786

6½ TONS "Presbrite" Nickel Plated Steel, in coiled strips, 4" × 0·024", polished one side, hessian wrapped and steel interleaved with tissue paper. This material (stocks of business recently purchased) for disposal. Cost £139 5s. 0d. per ton. All offers considered. Inspection invited or sample from Trumod Ltd., 205 Hook Road, Chessington, Surrey (Elmbridge 0044). [7780

PUBLIC NOTICE

EROSION OF TEETH.

THE Industrial Injuries Advisory Council are considering whether erosion of the teeth due to acid fulfils the conditions for prescription under the National Insurance (Industrial Injuries) Act, 1946, as a disease for which industrial injuries benefits may be paid, and if so, in relation to what occupations. Persons and organizations interested are invited to submit written evidence which should reach the Secretary, Industrial Injuries Advisory Council, 10 John Adam Street, London, W.C.2, by the 15th September, 1959. An explanatory memorandum will be sent on request. [7783

FOR ALL GRADED NON-FERROUS SCRAP METALS FOR FOUNDRY USE

CONTACT—

GOTHOLD BROS. (METALS) LTD.

STERLING WORKS, LEYBORNE AVENUE, EALING, LONDON, W.1.

Ealing 9248-9 & 0409 Cables: GOBROMET, London.

PURCHASERS OF WORKS' ACCUMULATIONS AND RESIDUES.

Members of The National Association of Non-Ferrous Scrap Metal Merchants.

JOSEPH LUCAS (ELECTRICAL) LIMITED

RESEARCH OF FLUID DYNAMICS OF PRESSURE DIECASTING

A vacancy exists for an

HONOURS GRADUATE

for research on the above subject

The successful candidate will be given the opportunity of spending the first two years of the appointment at a University, where he will be able to submit a thesis for a higher degree. The salary will be up to £650 per annum according to qualifications

Apply, in writing, giving details of age and qualifications to the Personnel Manager, JOSEPH LUCAS (ELECTRICAL) LIMITED, Great King Street, Birmingham, 19, quoting reference PM/D/264.

PLANT FOR SALE

CUPOLA (Copper Type), 48 in. × 30 in. hearth, 6-tuyere, complete.

ROTARY Furnace, Monometer 5 ton, complete, including spare shell.

SEMI-ROTARY Non-Crucible Furnace by Monometer, 350 lb. capacity.

CRUCIBLE Furnace, oil-fired, by Waterhouse, 600 lb. nominal capacity, complete.

PNEUMATIC Handling Plant for fume, by Visco. Designed to handle 30 tons of dry fume, density 60 lb/cu. ft., per 24 hours.

SEVERAL Underfeed Automatic Stokers, Mirrlees No. 25 Standard.

ATTRITORS by Alfred Herbert, one No. 6 and one No. 8, complete.

HEADGEAR and Control Panel for 2-ton Electric Goods Hoist.

PADDLE Blade Fans, Matthews & Yates Nos. 8 and 12.

ELECTRIC Motors, mainly Squirrel Cage for 3/50/400; 5 to 15 h.p.

STARTERS. Ellison Star/Delta Oil Immersed.

CAMBRIDGE Instruments. Thermographs, range 50°-500°C. and 100°-250°C.; Pressure Recorder, 0-3 lb.; Index Thermometers, with minimum contacts and relays, 0°-500°C. and 50°-500°C.

FOSTER Pyrometers. Thermocouples, 0°-650°C. and 0°-1,200°C.; Disappearing Filament type, 700°-1,500°C.

BURTONHEAD TRADING COMPANY LTD., BURTONHEAD ROAD, ST. HELENS, LANCASHIRE. Tel.: St. Helens 7508. [0020

SCRAP METAL (SALE & WANTED)

B. J. PERRY & CO. LTD. Exchange Buildings, Birmingham, 2, for Phosphor Bronze Swarf and Scrap and all Non-Ferrous Metals. Tel.: Midland 5986-7. [0013

"NIMONIC" Grindings, Turnings and Scrap required. Top prices paid. MITCHAM SMELTERS LTD. REDHOUSE ROAD, CROYDON, SURREY. Tel.: Thornton Heath 6101-3. [0007

NICKEL and High Nickel Content Scrap wanted. "Nimonics," "Inconel," "Monel," etc. Offer for best prices to Nicholson & Rhodes Ltd., Princess St., Sheffield, 4. Phone 27491. [0011

TIME RECORDERS

FACTORY Time Recorders. Rental Service. Phone Hop. 2239. Time Recorder Supply and Maintenance Co. Ltd., 157-159 Borough High Street, S.E.1. [0014

BOOKS

HANDBOOK of Industrial Electroplating. Second Edition. By E. A. Ollard, A.R.C.S., F.R.I.C., F.I.M., and E. B. Smith. Facts, figures and formulae for all who design, erect, maintain or operate electrodeposition plant, and for laboratory workers who deal with plating solutions. Includes sections on water and drainage, purification of solutions, safety precautions and ventilation in plating shops, and the special problems of costing in such shops. 35s. net from all booksellers. By post 36s. 5d. from Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

STEELS in Modern Industry. A Comprehensive Survey by 29 Specialist Contributors. General Editor W. E. Benbow. An invaluable guide for engineers, designers and draughtsmen; it specifies the steels best used in various engineering applications (bearing in mind the present need for economy), describes their general and special properties and characteristics, and how they may be surface finished for anti-corrosive and other purposes. 42s. net from all booksellers. By post 43s. 9d. from The Publishing Dept., Dorset House, Stamford Street, London, S.E.1.

GAS Welding and Cutting: A Practical Guide to the Best Techniques. By C. G. Bainbridge, M.I.Mech.E., M.Inst.W. A comprehensive textbook providing practical information on almost the whole range of available gas welding and cutting equipment, methods and processes. Invaluable to the practical welder as well as to those responsible for gas welding and cutting operations involved in the fabrication and repair of industrial equipment. Price 15s. net. By post 16s. 0d. From all booksellers or from The Publishing Dept., Dorset House, Stamford Street, London, S.E.1.

OXYGEN Cutting: A Comprehensive Study of Modern Practice in Manual and Machine Cutting. By E. Seymour Semper, M.I.Mech.E., M.Inst.W. Written to assist engineers concerned with cutting and shaping material, this book describes many of the machines designed for various applications of oxygen cutting to template with multiple heads and also the actual methods of operation. Price 10s. 6d. net. By post 11s. 4d. From all booksellers or from The Publishing Dept., Dorset House, Stamford Street, London, S.E.1.

MATERIAL Handling in Works Stores. 2nd Edition. By L. J. Hoefkens. Shows how the use of fork-lift trucks and pallets in industrial stores can increase production, utilize floor space more effectively, help control of movement and reduce costs. Includes a description of a system actually operated in a modern factory. 18s. 0d. net from all booksellers. By post 19s. 0d. from The Publishing Dept., Dorset House, Stamford Street, London, S.E.1.

INDUSTRIAL Brazing. By H. R. Brooker and E. V. Beatson, B.Sc.(Eng.), A.M.I.E.E. The first full-length study of this subject. Covers in detail all modern brazing methods, including torch, furnace, high-frequency induction, resistance, salt bath and dip, with chapters on the special techniques necessary for aluminium, stainless steels, beryllium copper, cemented carbides and vacuum tube construction. 35s. net from all booksellers. By post 36s. 6d. from The Publishing Dept., Dorset House, Stamford Street, London, S.E.1.

INDEX TO ADVERTISEMENTS

Printed in Great Britain by James Cond Ltd., Charlotte Street, Birmingham, 3. Published by Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1.